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AND

GAZETTE,

JULY 1ST — DECEMBER 30TH, 1848.

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VOL. XLIX.

" Where the victory can reap
A harvest crown'd with triumph, toil is cheap."
FORD.

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1848.

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TO THE FORTY-NINTH VOLUME.

ERRATA.

Page 319, col. 1, line 48, for 'is *not* free, read 'is *yet* free.'
337, col. 1, line 18, for 'exploded' read 'explored.'
393, col. 2, line 9, for 'O' read 'O_3.'
628, col. 2, line 17, for 'That a clear' read 'That clear.
631, line 21, omit the minus sign before 80m.
631 line 29, in the bracket, for $\frac{9}{4}\cdot\frac{\epsilon^{-\frac{2}{3}x}}{-\frac{2}{3}}$ read $\frac{9}{4}\cdot\epsilon^{-\frac{2}{3}x}$

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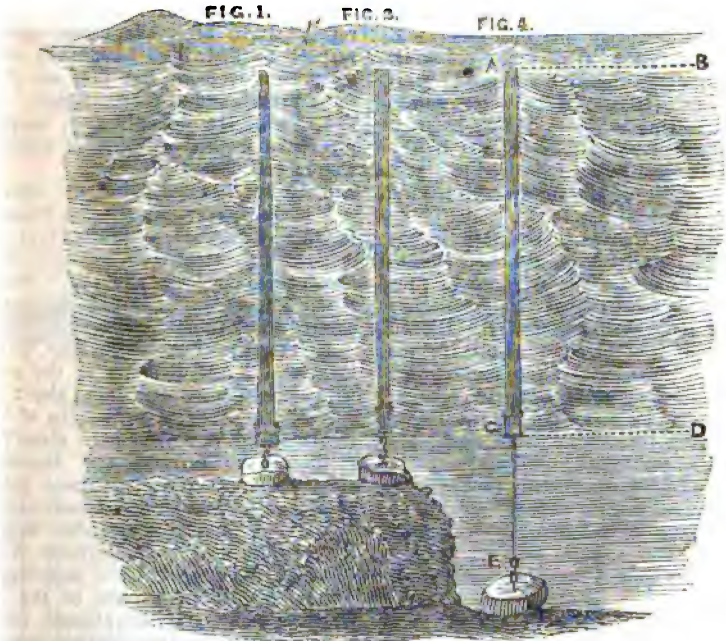
Mechanics' Magazine,

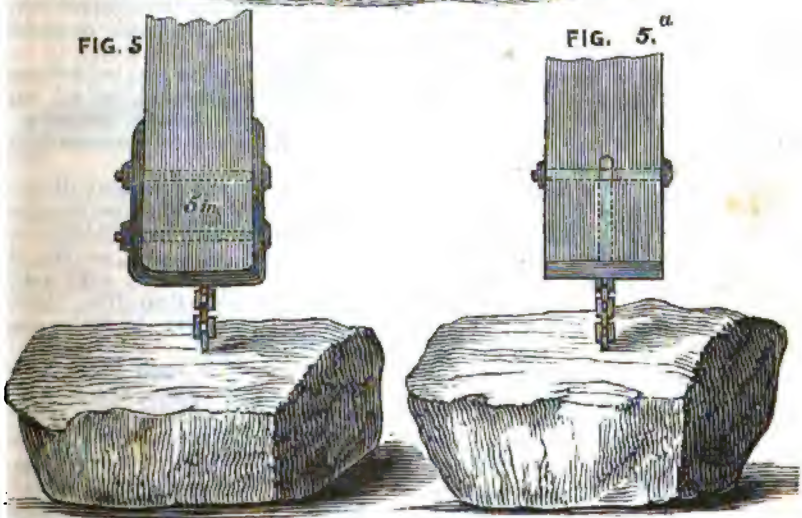
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1299.] SATURDAY JULY 1, 1848. [Price 3*d*., Stamped, 4*d*.

Edited by J. C. Robertson, 166, Fleet-street.

LIEUTENANT-COLONEL YULE'S BREAKWATERS OF VERTICAL FLOATS.





In prosecution of the mode proposed in vol. viii. of the "Professional Papers of the Corps of Royal Engineers," of resisting the force of waves by means of vertical floats, each spar having its separate anchor, I have taken an early opportunity, after returning from abroad, to make some experiments with them.

In Number 1230 of the *Mechanics' Magazine* there is a full account of various kinds of floating breakwaters and of the objections made to them; before I describe how these may be met by the use of vertical floats, I proceed to give a concise notice of the steps which led me to adopt that form.

When in Canada, I had seen booms made of squared logs, attached end to end by chains, for the purpose of preventing drifted timber from striking against the embankments of the Rideau Canal, and it occurred to me that if spars were fixed to booms, so as to make a sort of floating *chevaux-de-frise*, the force of waves would be lessened; but this frame being very limited in depth, was only fitted for breaking the surf.

These booms occasionally broke loose, and to guard against such an accident to a breakwater of this kind, I thought of reducing them to short frames; following up this idea, I arrived at the single spar.

The next consideration was the method of anchoring which I intended to effect by a chain (fig. 3) stretched between two anchors, and by attaching the spars to it. The objection to this was the same as to the above frame,—unwieldiness, liability to break loose, and the difficulty of repairing.

The obvious transition was then from the single spar to the single anchor (figs. 1 and 2.)

Referring to former opinions* on the subject of floating breakwaters generally, the objections to them are,

1. The expense and difficulties of complicated frames, and the doubts which prevail that any artificial floating structures can produce still water; the impossibility of preventing them from being carried from their moorings; the trouble of getting them out of water when injured, or of replacing them after being repaired.

2. Some are constructed so as to form a flat raft; these are of very limited use, as they could only break the force of the surf; vessels of considerable draught, or exposed to the ground-swell, would be little sheltered by them.

3. Light frames, "in imitation of reeds," have been suggested, and in respect to their lightness, they are a great improvement, but they are liable to be broken and to get entangled.

4. There are difficulties in adapting the above methods to different depths of water; and, also

5. To the rise and fall of the tides.

I shall now enumerate the remedies for these objections, premising that most of them were treated theoretically in the above-mentioned essay in the "Professional Papers," and have recently been confirmed by actual experiment.

1. The cost of the single spar, 22 feet long, and 5 ins. diameter at the stem, with stone anchor containing about two cubical feet, about 6 lbs. weight of iron fitments (figs. 5, 5*a*,) is here about four shillings, the carriage and launching about sixpence more; but these details of cost depend on local circumstances.

With an anchor of suitable weight, the vertical float is immoveable in any weather. The operation of launching is simple, and there is none of the risk which accompanies complicated structures, in effecting the complete renewal or removal of a breakwater consisting of them.

2. Spars 24 feet long are sufficient to reach the whole depth of the largest waves; they supersede, therefore, the "flat raft," which only protects the surface.

3. The vertical floats have all the advantages of the light frames in imitation of reeds, without their liability to be broken and entangled, as the short chains of three or four links are just enough to allow their free vibration; they also give way to boats passing amidst them.

4. In order to reach below the level agitated by the waves, and to suit the irregularity of soundings, an iron rod, weighing about one pound to the foot in length, is inserted into the spar (fig. 4,) and the lower end of it is attached by a short chain to the anchor.

5. With respect to the rise and fall of

* See No. 1230 above mentioned.

the tides, it is to be observed that on shores where the depth of water is not sufficient to float the spars at ebb tide, they will lean over, and in rough weather have a tendency to wear each other.

To guard against this, I propose to have a series of the spars (fig. 6, *a*,) so placed as to float nearly vertically in the lowest tides, leaving (say) 5 feet of their tops above water.

FIG. 3.

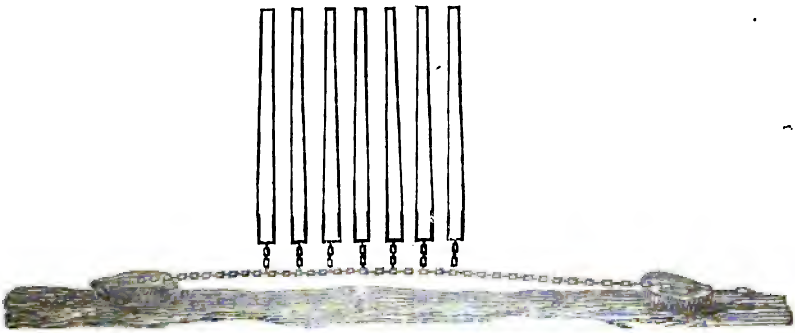
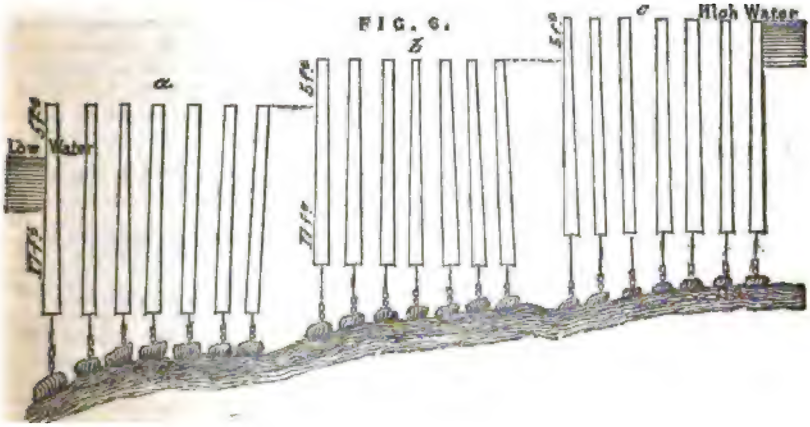


FIG. 6.



The next series (*b*) will be placed the same height (5 feet) above *a*; in like manner the series *c* above *b*, until the upper series is on a level with high water, or a little below it.

By this arrangement, each series in succession will be protected during its subsidence into the quiescent state, as well as its rising from it.

The experiment alluded to above, is now in the course of operation on the shore of the Forth, at Portobello, about four miles to the eastward of Edinburgh.

Upwards of 600 spars have been anchored in a group of about 30 yards by 20, with anchor and chain; their tops are about 9 feet above ground; they are from two to four, or five feet apart.

These spars had been anchored nearly a month before I had an opportunity of witnessing their effect in a strong breeze blowing direct on shore. There was a considerable swell at the time, and the tide nearly covered them, when, greatly to my surprise, I perceived that the wave seemed to increase in size as it passed over them. I continued on the look out to ascertain if it was really the case, and after a few moments' reflection, I came to the conclusion that it must be so on the windward side.

The wave as it advances is suddenly

checked in its velocity, and being confined in space by the spars, it rises in height to obtain room for itself.

The next coming wave is checked in like manner, and as it overtakes the first wave its velocity will receive an additional check, so as to be sooner overtaken by the third wave, and so on successively, while the whole in their progress will be more and more involved in the group of spars, and finally reduced to quiescence.

I have no data yet to enable me to decide what breadth of the group of spars may be sufficient for the purpose. I am extending it to 60 rows or yards, and double that number may be required; but considering their moderate cost, there are many occasions, when the advantage of still water would be cheaply obtained for the expenditure.

In addition to the ordinary object of breakwaters, this system, on account of its adaptation to nearly every kind of shore, will be available where relief, if not immediate, comes too late; for instance, in the case of a stranded ship.

In the course of two or three days, a ship in this situation might be surrounded by a number of spars, and saved from further injury. For such an important object, it would be worth the expense to have depôts of spars and anchors ready for use at several of the principal harbours. They may be used for the protection of sea-walls or lighthouses during the time of their construction; if the ground is rocky, the spars may be attached at low-water to the rock itself.

Small harbours for boats engaged in the herring fishery might be established, and removed every season. In the Highlands, where young fir-trees are plentiful, they might be launched at little more than the cost of the iron fitments, viz., at from 1*s.* to 1*s.* 6*d.* each, according to the size of the spar.

The channels of rivers liable to be obstructed by sand or shingle, may be kept open by this mode, which can be more easily applied than by driving piles or constructing frames for that purpose.

The shingle which is constantly shifted to and fro on the southern coast of England, might be confined to fixed points. It is probably for the latter purpose that the vertical floats may be found best adapted.

Reverting to the paper in No. 1230 of the *Mechanics' Magazine*, a new proposition is introduced in it for obviating the objections to *framed* works for breakwaters; it is simple, light, and manageable; not liable to injury, and it would be easily repaired. It is also suited to a variety of depths of water, and to the rise and fall of the tides—a quality which does not appear to have been attempted, or so essential as to be considered requisite, in preceding modes of construction, though without it all are nearly nugatory.

It remains to be decided by trial how many lines will be required. From the nature of this construction, being connected above as well as below, it is probable that few lines may be necessary, so that this mode will be effectual where others could not be rendered so for want of space.

Before concluding this paper, it should be mentioned, that in addition to the short spars of 8 feet long above mentioned, two have been floating for several weeks of the following dimensions: one a spar 22 feet long; the other a spar of the same length, but with 18 feet of iron rod attached to it, as in fig. 4.

The drag on the anchors of each is calculated thus:

	lbs.
The spar, which was well seasoned, weighed	30
The iron fitments for the anchor	5
	35
The cubical extent of the spar is about 2 feet, the displacement of water by which is . .	124
Leaving for buoyancy	89
The stone anchor contains also about 2 cubical feet, and weighs about	300
The same mass of water weighs	124
Making the weight of the anchor in water .	176
Deduct the buoyancy as above	89
	87
The remainder is the power of resistance of the anchor to the drag on it by the weight and vibration of the spar.	
The other float which is in 40 feet depth of water, consists of the spar, weighing as above	30
Iron fitments also	5
18 feet in length of iron rod	18
	53
Water displaced nearly	122
Leaving for buoyancy	69
Weight of anchor in water as above . . .	176
Deducting the buoyancy, the remainder is the resistance of the anchor to the drag and vibration of the spar.	107

Since the above was written, it has been stated to me as an objection to the vertical floats, that a strong running tide

will affect their efficiency, by causing them to remain in an inclined position: this I do not anticipate in a material degree. The spar, in the course of its vibration, will be struck by the wave at various angles of inclination, with a constantly changing and inappreciable effect.

Edinburgh, 10th June, 1848.

MATHEMATICAL PERIODICALS.

(Continued from p. 583, vol. xlviii.)

VIII. *The Enquirer.*

Origin.—This periodical was commenced at Boston, in Lincolnshire, in the beginning of the year 1811, and was discontinued with the 11th number, in May, 1813.

Editors.—The first two volumes were jointly edited by Mr. P. Thompson, of Boston, and Mr. William Marrat, author of a "Treatise on Mechanics," "Mechanical Philosophy," "History of Lincolnshire," &c.; the last three numbers were edited by Mr. Marrat alone.

Contents.—Each number of the work was divided into two portions. Under the head of the "Juvenile Department" were given prize subjects in the Latin and French Languages; English Composition, and Junior Mathematics; Translations from the Latin and French Languages; English Themes; English Verse, and Answers to the Junior Mathematical Questions. The Department for "General Correspondence" contained Essays on English Grammar; Critical and Grammatical Observations; Essays on Antiquities, Topography, Etymology, Curiosities and Coins; Account of, and Extracts from, Rare and Curious Books; Extracts and Essays on various subjects in the Arts and Sciences; Chemical and Philosophical Essays and Queries; Useful Recipes in the Arts and Manufactures; Miscellaneous Essays; Poetry, original and selected; Mathematical Papers, original and translated; Mathematical Questions and Solutions, for which various prizes were awarded, &c. Among the many interesting and elegant contributions to this well-sustained and valuable periodical, may be mentioned a series of racy articles entitled, "My Lumber Room;" "Account of the Books used in Churches and Monasteries before the Reformation;" "On the Art of Ringing Bells;" "Pensées Detachées;" "On the Dry Rot:"—a series of valuable papers entitled "A Survey of the Roman Antiquities in the County of Lincoln," well worthy of attention, which were contributed by Mr. P. Moore, of Bourne, in Lincolnshire, who died shortly after their publication: "Imitations of the Poetry of Henry Kirke White;" "On the Dissolution of the World;" "Bibliographical Anecdotes;" "Specimens of the Similarity and Connection of Languages;" "On the several sorts of Vicious Arguments called Sophisms;"—a series of articles arranged under the heads of "Gleanings" and the "Collector," containing a number of very curious and interesting particulars connected with old usages and customs, the origin of common proverbs, &c.; "On Gravitation," by Mr. P. Thompson; "On Female Education," from the *Edinburgh Review;* "On Vegetable Instinct and the Sleep and Sensation of Plants," by Mr. Tapper; "Critical Essay on the Prophecies of Daniel;" "The Commodities of Arithmetic," from the "Grounde of Artes," by Roberte Recorde; "On the Unevenness of the Earth's Surface;" &c. The poetic department was also well sustained, and many of the queries are worthy of attention from their curiositity, usefulness, and importance. In the mathematical essays are articles on "The Composition of Forces," and "The Equations of Motion," translated from Francœur by Mr. Marrat; "The Properties of Infinites and Nothing;" "Observations on a Curious Mechanical Problem," by Mr. Marrat; "Investigation of Formulæ for the Values of the Tangent and Cotangent of an Arc," by Mr. G. Harvey, Plymouth; "On the Properties of the Lever," by Mr. A. Hirst, Marsden; "Geometrical Problems by the Compasses alone," from Macheroni's *Géométrie du Compas;* "Essay on Fluents," by Mr. G. Harvey, &c.

Questions.—The total number of mathematical questions proposed and answered in the senior department is 155; most of those left unanswered on the discontinuance of the work were solved in the first number of the *Leeds Correspondent.* The editor appears to have exercised good taste in the selection of his questions and solutions, most of them being of a very interesting and practical

character:—the application of Algebra, Diophantine Analysis, Geometry, and Mechanics, appear to predominate, and would supply many a "dainty morsel" to the "getters up" of a series of examination papers. The work contains more of the able and elegant investigations of Mr. John Ryley, of Leeds, who wrote under the signature of "Rylando," than any other work with which I am acquainted.

Contributors.—The principal contributors were Messrs. Allen, Baines, Bruster, Butterworth, Cook, Dunn, Eyres, Gawthorp, Harvey, Hine, Hirst, Jones, Johnson, Kay, Maffett, Nesbit, Putsey, Shaw, Tomlinson, Webster, Whitley, Winward, &c.

Publication.—It was issued in quarterly numbers, which were printed for the editors by Whittingham and Rowland, Goswell-street, and sold by Scatcherd and Letterman, Ave Maria Lane, London; and Thompson and Barnett, Boston.

*** I cannot dismiss this periodical without expressing a regret that circumstances should have arisen which rendered its continuance impossible. Mathematical periodicals at all times appear to have been unproductive speculations. Fortune seems to be adverse to their prosperity, however auspiciously begun, and in this case the editors were destined to experience their full share of what is too often the lot of those who are anxious to live and labour for the good of mankind. The *Diaries*, no doubt, would long ago have ceased to exist, if they had depended *solely* upon their own intrinsic merits and usefulness for support; it is perhaps more than conjectural that the profits derived from the more vendible *Astrological* and *Weather* predictions of *Old Partridge* and *Francis Moore* serve to buoy up in some degree the otherwise *dead weight* of Diarian speculations. The Liverpool "Student," that "work of rare merit," as Professor Davies well observes, divided a profit of *five guineas* among its principal contributors, arising from the sale of the first three numbers; the fourth number was a "dead failure," and the work was discontinued. "Commercial distress" has often been urged by the proprietors of such publications, when every effort has failed to prolong their existence; but, divested of its *technicality*, the expression has too frequently signified *ruin to themselves* and no sale for the work. One after another of the periodicals has passed out of existence, to be succeeded by others as ephemeral as themselves. "Leybourn's Repository" and the "Gentleman's Mathematical Companion," would seem to be exceptions, since they attained to a *comparatively* "patriarchal age," but probably some under-current of *self-sacrifice* enabled these vessels of science to ride so long in safety. Nor is the *lack* of support a thing unknown even in the present dearth of such publications. *Already* the "*Cambridge and Dublin Mathematical Journal*" has hoisted its signal of distress, and if such is the condition of a journal published at "the first University in the world," who can venture to predict the long continuance of its worthy contemporary, the *Mathematician*. Mr. Marrat informs me, in one of his excellent and interesting letters, that they printed 750 copies of the "Enquirer," all of which were sold, except 20 complete copies, that remained when the work was given up. "The publishers and the printers got all the money as the numbers were sold, and at the close of the business we got a bill for £130!!! So we did all the work, and lost that sum into the bargain." Some valuable remarks on the efforts which have been made by the "Non-Academics" of this country for the furtherance of science, are given in a late volume of the *Phil. Mag.*, by "J. J." (your own "Exoniensis," I believe,) and with what success may be seen in an excellent letter from Professor Davies, inserted in pp. 428-31, vol. xlvi. of this Magazine. It is therefore unnecessary for me to dilate on this subject, but I must crave your indulgence while I show, that to Mr. Marrat the above was only "the beginning of sorrows." In 1810 he published, by subscription, "An Introduction to the Theory and Practice of Mechanics;"—a work which has been pronounced by one of the best living authorities, as "the first book of its class at that time in England;" it was dedicated to Dr. Hutton, and gained the author much repute. His connexion with several other publications, and the editorship of the "Enquirer," served to increase his fame, and shortly after its discontinuance, on the advice of several influential friends, and under the *avowed patronage* of Sir Joseph Banks, he commenced the publication of "The

History of Lincolnshire," a work for which his previous studies had eminently qualified him. "The patron and the gaol," says the authority above alluded to, "have been linked together by one who *knew*, because he had *felt*, the *effect of such patronage* as the aristocracy and the squirearchy confer," and Marrat was soon to learn by bitter experience that *he* formed no exception to the general rule. He says, "At the request of several gentlemen, I began to publish a History of Lincolnshire, and in the presence of my worthy friend Mr. (afterwards Sir John) Rennie, the celebrated engineer, Sir Joseph Banks promised me the use of all his papers. The work was published in numbers. I carried it on for about four years before I applied to Sir Joseph. It was pretty well known that he had many valuable documents relating to the history of the county, and I mentioned on the wrappers of the numbers that Sir Joseph Banks had granted me the use of all his papers, on which account the work sold extremely well. When I wrote to him I told him, that, with his permission, I would go to Revesley Abbey, where he resided when in the country, and take copies of such papers as would be useful to me, without taking them from his possession, because I thought that would prevent any suspicion (for I knew that he sometimes had strange freaks) that might arise about my not returning his papers. He answered my letter by *saying that he knew nothing about me; that I had made an undue use of his name on the wrappers of the numbers I had published; that he never promised me the use of his papers, nor should I ever have any of them.* On reading the letter I thought the man was mad, but what could I do? In my own justification, I had a letter from Mr. Rennie, which stated, that 'Sir Joseph, with his usual urbanity, *had* granted me the use of all his papers,' which I showed to Lord Brownlow and some other noblemen and gentlemen who patronised the work; but when Sir Joseph had thus acted, they were of opinion that the work could not be carried on, because his papers were thought to be extremely valuable. I therefore gave up the work, and was nearly ruined." In a subsequent letter Mr. Marrat says, "The reason why Sir Joseph Banks used me so shamefully, I am fully persuaded, was, that he *had no papers*, and he was not honest enough to acknowledge it, seeing it had gone forth to the world that he had some valuable documents concerning the antiquities of the county. Besides which, he did not know that I had *friends* who would avenge me of such usage. He was not aware that Dr. Hutton and Dr. Gregory were friends of mine, and would take up cudgels in my favour." Little need be added by way of comment upon the preceding statement: suffice it to say, that Mr. Marrat *never recovered* from the *effects* of Sir Joseph Banks's *patronage* and *urbanity*, and that he still exists in the most straitened circumstances, a venerable monument of blighted prospects, in consequence of relying too much upon the *readily promised* but *rarely exercised* patronage of the great.

Yours, &c.,

THOS. WILKINSON.

Burnley, Lancashire, June 24, 1848.

[We have heard before of the affair referred to at the close of our correspondent's letter. Of course Mr. Marrat's own version must be taken as the true one, so far as he was himself concerned: but we believe that Sir Joseph Banks did possess some valuable papers respecting the history of his county; and it may be as well to mention that Sir Edward Knatchbull, Bart., and Mr. Dawson Turner, as his executors, most probably possess them. This may serve as a hint to any other inquirer into the history of the county of Lincoln, as to where materials of value may, in all probability, be obtained.

As regards the actual reason of Sir Joseph's conduct towards Mr. Marrat, we have heard, upon what we deem very good authority, that it was neither more nor less than the dedication of his work on "Mechanics" to Dr. Hutton. Those of our readers who are familiar with the history of the Royal Society, and the ejection of Dr. Hutton from its secretaryship, will be able to fill up the picture.

The Royal Society, however, is not a palatable subject with us; although it is probable that we may shortly be induced to take some notice of the present dissensions by which it is torn almost to pieces.—ED. M. M.]

RISHTON'S IMPROVED VINERY FRAME.

[Registered under the Act for the Protection of Articles of Utility. Henry Rishton, of Kendal, plumber, Proprietor.]

FIG. 3.

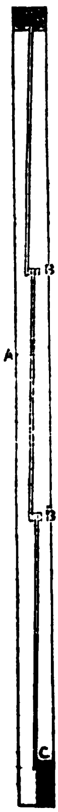


FIG. 1.

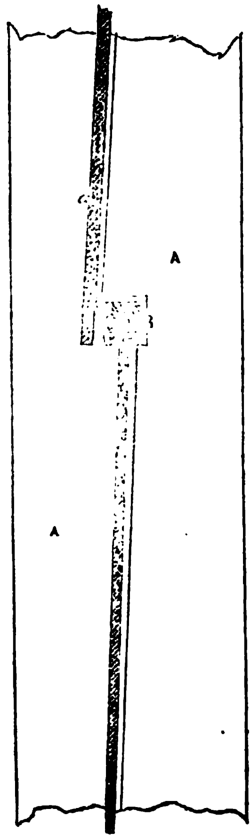


FIG. 2.

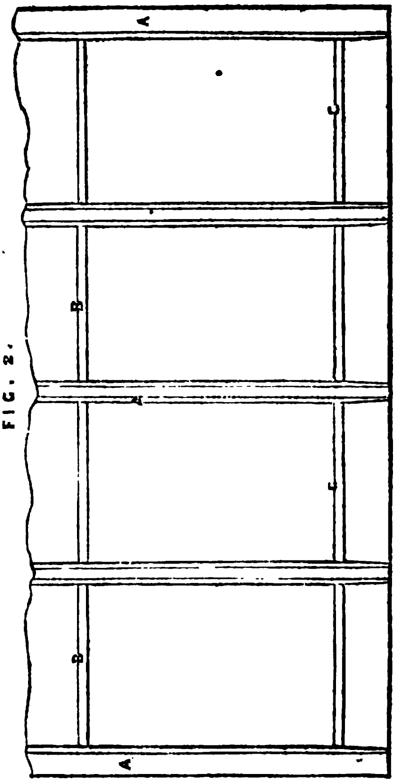


Fig. 1 is a longitudinal section of part of a frame, on this improved plan, of the full size; fig. 2 is a plan, or a smaller scale of one-half of a complete frame, and fig. 3 is a longitudinal section of fig. 2. A A, are the styles and astragals of the frame; B B, cross-bars of thin metal into which the upper ends of the squares of glass (*a*) are inserted and made fast by putty, as shown in fig. 1. Each square of glass is kept at the bottom, a short distance clear of the bar, B, which it overhangs, which prevents the collection of water and discoloured matter at the lap, and leaves also room for the expansion of the glass, so as to exclude all chance of breaking from frost; while at the same time ventilation is facilitated, and any square of glass may be removed without disturbing the others. C, is a strip of angle-shaped metal which carries off the water outside when it arrives at the bottom.

ON THE EFFECT OF SUPERINCUMBENT PRESSURE AS REGARDS THE QUESTION, WHETHER SEA-WALLS SHOULD BE SLOPING OR VERTICAL. BY HUGH M'CORMAC, ESQ., M.D.

Sir,—Although one of the uninitiated, permit me to advert to a very important point in the construction of sea-walls, which marine engineers, so far as I know, have hitherto overlooked—namely, *superincumbent pressure*. This seems to me one of the first elements to be taken into account. We all know that when a stone is immersed in water, it loses of its weight equal to the weight of the mass of water which it displaces. It is this circumstance which gives the moving surge, itself almost of the specific gravity of oak, the enormous power which it has over the stone. This, however, may be counteracted, under whatever exigency, by adequate superincumbent weight. It is owing to the latter, that the chalk-cliffs of Britain have withstood, as they have done, though of so soft a material, the assaults of the ocean through so many thousand years. It is owing to this that we are still enabled to admire and venerate the handiwork of Smeaton, in the Eddystone, which the sea vainly lashes with an almost undying surge. This consideration of superincumbent pressure, at once decides the preference in favour of perpendicular sea-walls and breakwaters. If superincumbent pressure had been resorted to, the breakwater at Plymouth, or that at Cherbourg, would not have had its summit, though formed of massive stones, torn away. And if the harbour of refuge at Dover be formed on any other principle, it will prove a source of bitter regret to all concerned, as well as of heavy expense to the nation, from the unceasing dilapidations which must necessarily ensue. Let the sea-wall of this and other refuge harbours be formed of massive stones, properly based and bonded, and built into an upright wall, *with a sufficient amount of superincumbent pressure*, and it will last all the ages of the island itself. But if constructed otherwise, it will not last at all; as you and I shall doubtless live to see, if they try it. And why is superincumbent pressure, it may be asked, so advantageous? Why, simply, because it imparts that stability to the underlying masses of stone, which they are liable to lose; partly owing to their immersion, and partly owing to the rush of the sea. A stone of ten tons surmounts a sea-wall. It may be thought sufficient: but a gale comes; the stone is immersed, loses of its weight and stability together; heels over with the rush of the sea, and is displaced. The one beneath shares the same fate; and so the structure, albeit massive, is destroyed. But surmount the whole with sufficient additional weight: let the ten ton stone be loaded with a hundred, or a thousand tons, if necessary, above the point of immersion; and all the power of the elements, if the wall be only properly bonded, will never affect it. It is the flying buttress which enables the cathedral wall to resist the side thrust of the arch: we must, in the same manner, resort to a flying buttress, but proportionately massive, to resist the thrust of the sea. I saw very well that this was what was needed, when there was talk some time ago about a harbour of refuge on the Goodwin Sands. I saw that if they built a proper sea-wall—that is to say, an upright one—resting on Pott's or Mitchell's piles, whichever was found most eligible, and raised it high, above the utmost wash of the sea, with an adequate amount of superincumbent weight, in the form of what I might call a marine (flying) buttress, that the storm might blow and the sea flow, without ever impairing the stability of the structure. It was clear that the toy which was put up, or any similar toy, could not possibly withstand the wear and tear of the sturdy elements. Living or dead, I hope to have the satisfaction of knowing that what I here propose has been done; and that a "harbour for all nations" shall one day occupy a spot now devoted to desolation and death.

A correspondent, W., in your able Journal, May 13, p. 463, adduces another point in favour of vertical walls, of very great, and, taken in connexion with the consideration of adequate superincumbent pressure, of conclusive weight. He quotes from Professor Airy—"The peculiarity," observes Professor Airy, "in the effects of an upright wall from the bottom of the sea, is this, that the sea does not *break* upon it." No, indeed, it does not. I have observed this in the Gobbins, near Belfast; at Donaghadee harbour; at the Deserta Isles, near Madeira: and it may be witnessed, I believe, at the cliffs of Kilkee and of Lake Superior. The professor adduces several other instances of

this circumstance, which I do not recollect having been noticed by any one else. It is however most important; and taken in connexion with adequate superincumbent pressure, as I have just ventured to state, highly so.

It is hardly necessary to adduce further arguments in favour of a position that ought, when stated, to carry conviction along with it; nevertheless, when one considers the yearly losses which sea-dykes and esplanades everywhere entail, it should suggest a suspicion of some fundamental error in the construction. Instances of this will be present in the mind of every one. Our good friends and neighbours the Dutch lay out vast sums of money yearly in keeping up their dykes and holders. Let us suppose they had been of stone, vertical, and surmounted above the highest rise of the water with a massive wall, the sea might boom and roar for ever, or so long at least as the living rock endures, without entailing injury; and consequently, without entailing fresh expense. I am, &c.,

H. M'Cormac, M.D.

Belfast, June 5.

[We shall give a paper by Mr. Dredge on the *opposite side* in our next.—Ed. M. M.]

NOTES ON THE THEORY OF ALGEBRAIC EQUATIONS. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

(Continued from vol. xlviii., p. 607.)

Second Series. Note E.

Let $\quad F^n(x, y, z,.,.)$

represent a *general* function of the n-th degree and of the quantities between the brackets which follow it, so that F differs from f inasmuch as the latter denotes a *homogeneous* function. Then the equations

$$F_1^2(x, y, z)=0, \text{ and } F_2^2(x, y, z)=0,$$

are two simultaneous and general "tertiary" quadratics which may, by "simple" quadratics only, be solved in a manner which differs from the solutions previously given or alluded to,* is easy of application, and capable of an interesting comparison with Mr. Jerrard's Method of treating similar questions.

Multiply the last of the given equations into an undetermined quantity λ and add the product to the first, then we have

$$F_1^2(x, y, z)+\lambda F_2^2(x, y, z)=0 \,.. (23.)$$

determine λ so that x^2 may disappear from (23.), then this equation will take the form

$$Bx+F^2(y, z)=0, .. (24.)$$

where $\quad B=cy+dz+e;$

let $B=0$ and eliminate z from (24.), then that equation will take the form

$$F^2(y)=0$$

an ordinary quadratic from which y may be determined. We may next obtain the value of z from $B=0$, and finally that of x from either of the given tertiary quadratics or from (24.)

Again, the above tertiary quadratics may be solved by the following process, which somewhat resembles the preceding, but which entails upon us the solution of a *biquadratic*, and which is, consequently, of interest only so far as it affords an example of a general method of proceeding.

Put one of the given equations under the form

$$x(bx+B)+F_1^2(y, z)=0,$$

assume that

$$bx+B=0 \ldots\ldots (25.)$$

and by means of (25.) eliminate x from each of the given quadratics, we shall then have two resulting equations of the form

$$F_1^2(y, z)=0 \text{ and } F_2^2(y, z)=0$$

whence y and z may be determined, and x may be obtained from either of the given quadratics, or from (25.)

Next let it be required to solve the system

$$\left.\begin{array}{l} F_1^2(x, y, z, p, q)=0 \\ F_2^2(x, y, z, p, q)=0 \\ F_3^2(x, y, z, p, q)=0 \end{array}\right\}.$$

Omitting for convenience the quantities between the brackets, form the equations

$$F_1^2+\lambda F_2^2=0 \ldots (26.)$$

$$F_1^2+\lambda' F_3^2=0 \ldots (27.)$$

and determine λ and λ' so that x^2 may vanish from (26.) and (27.), then those equations will take the form

$$B_1x+F_1^2(y, z, p, q)=0 \,.. (28.)$$

$$B_2x+F_2(y, z, p, q)=0 \,.. (29.)$$

where B_1 and B_2 are linear functions of y, z, p, and q. By means of the equations

$$B_1=0 \text{ and } B_2=0 \,.. (30.)$$

let p and q be eliminated from (28.) and (29.), then those equations will become

$$F_1^2(y, z)=0 \text{ and } F_2^2(y, z)=0,$$

whence y, and z are known; and p, and q are given by means of the two equa-

* *Mech. Mag.*, vol. xlviii., pp. 539 (III.) and 605, *seq.*

tions marked (30.); and finally, x may be determined from any one of the given quadratics.

In entering upon speculations of this kind we appear to have arrived at a rich mine of discovery. But here, for the present, I leave them, and bring the Second Series of these Notes to a conclusion. Should it be permitted me to resume the subject—and I hope shortly to have an opportunity of doing so—I shall give a discussion of the various solutions of the question known as "Colonel TITUS's Problem."* But I am desirous of stating here that the solution of FREND in its principle involves important consequences, and that the solution of the equations (4.), (5.) and (6.) of p. 512 of the last volume of this work is a generalization (or rather an extension to the general case) of the method which FREND employed in a particular instance. But neither does FREND appear to have been aware of, nor subsequent writers to have noticed, this generalization. Any narrowness of view on the part of FREND will probably be attributed to a confined *system* of envisaging a subject rather than to a defect of analytical power, and perhaps there are some who will agree with me in thus thinking that nothing but such a system, and an imperfect conception of the true nature of Algebra, could have rendered (comparatively speaking) nugatory the scientific enthusiasm, the ardour, and the disinterested zeal of such men as MASERES and him to whom I have just alluded.

I take this opportunity of mentioning with respect the name of Mr. LOCKHART in connection with the subject of equations. I hope on another occasion to call attention to some of his investigations.

2, Church-yard Court, Temple. June 24, 1848.

Errata.

Vol. xlviii., p. 606, col. 1, note †, line 5; *before* "form" *add* general.

———, p. 606, col. 1, note †, line 6; *before* "=" *add* +A.

———, p. 606, col. 1, note †, *between lines* 6 *and* 7 *insert*,

where $A = bx + cy + dz + ep$.

———, p. 607, col. 1, note ‡ [line 4] equation (β), transpose x and y.

* See some remarks on this problem at p. 159 of Prof. J. R. Young's *Mathematical Dissertations*, (London, 1841,) at pp. 272—274 of Prof. T. S. Davies's *Solutions to Hutton's Course*, (London, 1840,) &c. The method of Messrs. Whitley, Settle, and Ryley, is identical in principle with that of FREND.

THE WAVE PRINCIPLE IN SHIPBUILDING.

Mr. Scott Russell gave a lecture at the Royal Institution on the 2nd instant, on the new principle introduced by him into ship-building, called the Wave Principle. We extract the following abstract of it from the *Athenæum*: Mr. Russell's object was—*first*, to explain his theory of naval construction; *secondly*, to connect with that theory practical rules for the construction of ships; and, *finally*, to state the results which have followed the adoption of the form resulting from this principle,—by the general adoption of which the velocity of merchant steam-ships have, within twelve or fifteen years, been raised from an average of nine or ten miles to an already achieved speed of seventeen or eighteen miles an hour. The theory is derived from the observed properties of what Mr. Scott Russell has termed *the solitary wave of translation* (or the wave of the first order), and those of the *gregarious wave of oscillation* (the wave of the second order). The first-named wave moves with a velocity which can neither be accelerated nor retarded by the velocity of the floating body which produces it; while the latter does depend on the speed of the boat by which it is caused. The solitary wave is formed by the bow of a ship when in motion, and its velocity depends on the curve of the water-line of the vessel. Mr. Scott Russell proceeded to connect with these properties of the waves he described the following principles of naval architecture:—1. The principle of removing the least quantity of water to the least distance. Assuming that all horizontal motion through a fluid implies the displacement of that fluid, it is obvious that the amount of moving power required to propel a vessel will vary with the bulk of water disturbed and the range of its disturbance. In the ordinary construction, a great mass of water is set in motion on either side of the bows of the ship; but, as Mr. Scott Russell had proved experimentally in the wave boats, no more water was disturbed by them than was occupied by the immersed portion of the vessel.—2. The principle of adapting the form of the body which is to disturb the water to the natural form of the fluid which is to be disturbed. Referring to the properties of the wave of translation, Mr. Scott Russell proved that it was impossible to propel any vessel with a speed greater than that of the wave of the first order which it produced by its motion; and that, therefore, wherever speed was required, the shape of the vessel must be modified to accord with laws of that wave. Thus, the length of fast ships must be great (200 feet of keel being requisite to insure with least power a speed of 18 miles an hour, 300 feet of keel to at-

tain 23 miles, &c.) On the same principle, boats made on the wave principle are broadest abaft the middle; the lines of run are much finer in the bow than at the stern, the bow portion of the water-line being concave.—3. The principle of allowing the replacement of water to take place with the greatest possible velocity. The wave formed by the after part of a ship is not the wave of translation, but the oscillating wave of the second order. It arises from a vertical motion of the water from below to replace the hollow left behind the ship as it passes onwards. This replacement is most rapid when the stern portion of the water-line is full. Mr. Scott Russell mentioned that vessels of various kinds which had been built on the principles he described (although the principles themselves were not understood by those who acted on them) had always been remarkable for speed. The old Thames wherry, the smugglers' boats, privateers, the caique of the Bosphorus, fishing-boats in the North of Scotland, have been built more or less on this principle; and it was remarkable that whenever the form of any of these vessels was changed, with a view to improvement, the speed was always diminished. But the most important test of the wave principle of construction is afforded in the Holyhead fast boats,—all of which had systematically been constructed, with more or less accuracy, in conformity with the wave principle, and are propelled at the rate of from 17½ to 18½ miles an hour; the rapidity being the greatest in those boats in whose construction this principle is most accurately maintained. By the same principle, he felt satisfied that 23 miles an hour could be produced; and he was quite prepared to carry that speed practically into effect.

GROVES AND SONS' DOUBLE FILE-HANDLE.

[Registered under the Act for the Protection of Articles of Utility. Richard Groves and Sons, of Sheffield, Tool-makers, Proprietors.]

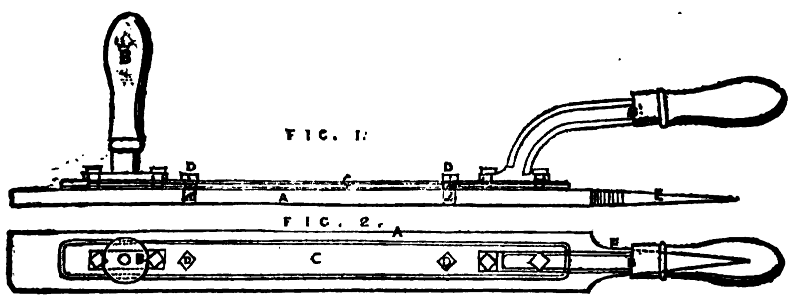


Fig. 1 is a side elevation of this very useful instrument in its complete state, and fig. 2 a plan of the same. A is the file; BB, the handles; C, a flat bar or plate, to which the handles are affixed; DD are two screws, which are passed through holes in the plate, C, into the file, which is tapped with a corresponding screw during the process of manufacture. When the file has been used on one side, the screws, DD, may be taken out, and the handle fixed on the reverse side; or the file may be used by placing a handle on the tang, E, as files are generally used.

DODDS'S RAIL-STRAIGHTENING MACHINE.

[Registered under the Act for the Protection of Articles of Utility. Isaac Dodds, of Glasgow, Civil Engineer, Proprietor.]

Fig. 1 is a front elevation of this machine, and fig. 2 is an end elevation of the same. AA is the bed-plate of the machine; BB are two pillows or supports, upon which the bar to be straightened is laid. CC is the pillar of the press, which is cast in one piece with the bed-plate, A; D, the nut, formed of the upper part of the pillar. E is the screw, and F a stud-piece, which forms the opposing point of strain to the pillows, BB.

The bed and pillar of this machine being of one piece, are consequently of much greater strength than the machines of this kind hitherto constructed, which

FIG. 1.

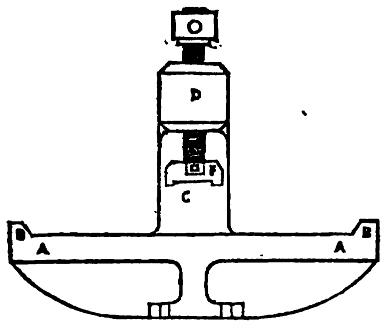
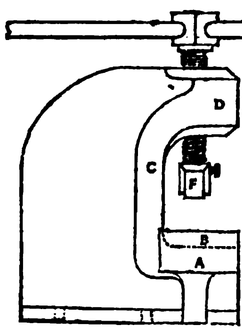


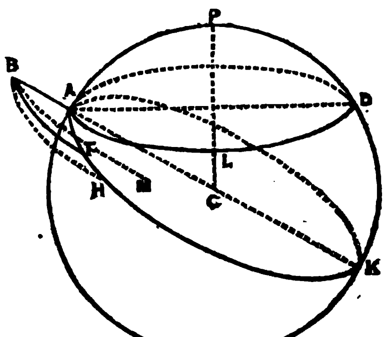
FIG. 2.



have been always made in separate pieces.

ON THE DEVIATION OF FALLING BODIES FROM THE PERPENDICULAR.

Several experiments have indicated, that bodies falling through great heights, do not drop into the position occupied by a plummet suspended at the point from which the body falls, but somewhat to the south and east of it. The latter deviation is in accordance with what might be expected as a result of the earth's rotation on its axis; but an explanation of the former did not appear so obvious. The influence of Diamagnetism was, we believe suspected, and with a view to determine this, the experiments detailed in a paper by the Secretary, published in the last Report of the Royal Cornwall Polytechnic Society, and which appeared in a late number of this Magazine, seems to have been instituted. These experiments, on account of the great discrepancies among them, cannot be considered satisfactory as respects the amount of south deviation; but that such a deviation did exist in those cases, seems clear. Mr. Rundell attributes it to the increased time occupied by a body in falling, occasioned by the resistance of the air, and in the examples given, supposes it proportional to the square of this increase of time. Now this explanation has reference only to the peculiar mode of calculation which he has adopted, and the omission of an agency which, though perhaps of little effect in those particular instances, must greatly modify general views of the subject. Our purpose is to give the method of estimating more accurately the deviation, exclusive of the air's resistance, and afterwards endeavour to point out the manner in which the air will effect it.



Let PAKD be a great circle of the earth (assumed to be a sphere) passing through the pole P and the point A; AB, a perpendicular to the surface at A, and B the point from which the body falls. Also, let AFHK be a great circle passing through A, whose plane is perpendicular to the plane of the former; and ALD a parallel of latitude, also passing through A. At the instant of the bodies being dropped those circles are supposed to become stationary, while the point A, and perpendicular AB move with the earth on the parallel of latitude ALD. If the body were not intercepted by the earth it would describe an ellipse, of which the centre of the earth would be either a focus or centre, according as the space through which it fell was without or within the surface; its plane likewise would be the plane of the circle AFHK. Whence, if BF represent the path of the body, it will be a portion of an ellipse, and will meet the earth on the circle AFHK, so that the point on which it drops must be in a lower latitude than that from which it fell. We need not here investigate the process of finding this latitude, but will simply state the result.

Let l represent the latitude of the point from which the body falls; L, that of the point on which it drops; f, the ratio of the

force of gravity to the centrifugal force at the equator; s, the space through which the body falls; a, the ratio of the radius to the distance from the earth's centre of the point from which the body falls. Then, when s is without the surface of the earth, putting the radius $=r$

$$\sin L=\sin l\left(1-\frac{s}{r\left(\frac{a^3 f}{\cos^2 l}-1\right)}\right),$$

and when it is within the earth,

$$\sin. L=\sin l\sqrt{1-\frac{(a^3-1)\cos^2 l}{f-\cos^2 l}}.$$

By means of these expressions we may readily find the deviation from the true perpendicular of a body falling from any height either within or without the surface; for since $\sin L$ can be found, we have, $\sin(l-L)=\sin l\cos L-\cos l\sin L$.

If the earth were at rest, a plumb line would tend direct to its centre, and thus indicate the true perpendicular; but the centrifugal force arising from its rotation must evidently thow the plummet off, and thus cause a deviation in this likewise. If s represent the length of the plumb line, and D the deviation from the true perpendicular of the plummet, then, when D is small compared with the earth's radius

$$D=\frac{s\sin l.\cos l}{f-\cos^2 l}.$$

To illustrate these formulæ by an example: it will be found that in lat. 53°¼ nearly (*i. e.* the lat. whose sine is ,6) a body dropped (in vacuo) without the earth's surface through a height of 1254 feet falls 2·087716 feet from the perpendicular, while a plumb line of the same length deviates 2·087340 feet. Hence the body falls ,000376 feet south of the plumb line. Within the surface with a height of 1253 feet, the body deviates 2·087151 feet, while the deviation of the plumb line is 2·087089, which gives the deflection in this case ,000062 feet, or only ⅙th of the former. The reason of this is, that within the earth, the centrifugal force varies as the force of gravity; while without the surface the former increases, while the latter rapidly diminishes.

If, instead of an ellipse, we suppose the path described by the falling body to be a portion of a parabola, to which it will in reality very nearly approximate, we can easily show the near equality subsisting between the deflections of that falling body and the plumb line. In this case the velocity of the body in the direction of a tangent to the circle of latitude of the point from which it drops will be uniformly the same as that of the point; but when the deviation is small, the deflection in the plane of the circle of latitude varies as the square of the tangent to it described by the body, or as the square of the time of its description, since it is described uniformly; and consequently, the body is virtually under the action of the centrifugal force uniformly and constantly acting. Now, let s be the space through which the body falls, and also the length of the plumb line; t, the time of falling through that space; f, the centrifugal force, and g, the space described by a falling body in one second. Let also d represent the deviation of the body in the plane of the circle of latitude, and D the like deflection of the plummet. Then, by the theorem for uniformly-acting forces $d=fgt^2$; but since t is the time of falling through s, $t^2=\frac{s}{g}$; and, substituting this in the former, we get $d=fs$. To find the deflection of the plumb-line, since forces which are in equilibrium are proportional to the sides of triangles drawn in the directions in which they act, we have $1:f::s:D$, or $D=fs$. Wherefore $D=d$, or the deflection of the plumb-line is equal to the deflection of the body. This is the principle employed by Mr. Rundell, in the paper before referred to, with slight variation, and, of course, is not strictly accurate, but sufficiently so for the purpose for which it is required. While on this part of the subject, we would remark on the formula given by Professor Cowie, attached to Mr. Rundell's paper. From the context, it would appear that it is intended as an expression of the southern deflection from the plumb-line, in terms of the eastern deviation; but, in reality, it is the exact symbolical statement of Mr. Rundell's process for finding the south deviation from the true perpendicular; if e be supposed to represent the arc described by the point from which the body falls, instead of the eastern deviation. The note seems to give it this meaning, unless the terms "eastern deflection from the plumb-line" and "eastern deviation" signify differently; and if this be the case, it becomes unintelligible. However, that it is an error so far as respects the original intention, is clear; for Mr. Rundell's explanation and calculation by means of the figures given, imply the total independence of the two deviations of each other; or, in other words, the eastern deviation is assumed to be nothing. The result is not sensibly affected by this; but there is no advantage attendant on it, as will be seen by comparing the following expression, in which the eastern deflection is involved, with Professor Cowie's.

Put T = half the time of the earth's rotation, t the time of the body falling, $\pi = 3{\cdot}14159$, r the earth's radius, and d the deviation from the perpendicular, then

$$d = r \sin l \cos l \left(\frac{\sqrt{T^2 + \pi^2 t^2}}{T} - 1 \right)$$

To calculate the eastern deflection with perfect accuracy would be very laborious; but for small heights, it will be sufficiently near the truth to estimate it as equal to the product of the time of falling by the difference of the velocities of the extreme points of the space fallen through.

In examining the effect produced on these results by taking into account the action of the air, although we have no data to proceed with, even if the complex nature of its action did not preclude a very correct valuation, yet we shall find that they must become greatly changed by it, both in quantity and kind. The atmosphere revolves with the earth, and a foreign body, or a body not partaking of its rotary motion, if projected into it, must ultimately rotate likewise. But, before acquiring this ultimate revolving motion, its primary motion of projection will, by friction and resistance, be gradually destroyed. It is evident that the velocity with which the body will rotate cannot be the same as that of the air, unless its specific gravity be the same; and it will be less as the specific gravity and size are greater. For if a mass of fluid revolve, the centrifugal force of any portion must be equal to the resistance of the next exterior portion; and if, instead of this first portion, a body of greater weight be substituted while the velocity remains the same, the resistance of the external part will be no longer equal to the centrifugal force, and hence the body cannot revolve with it. But if the velocity of the body be diminished so that its centrifugal force may be equal to that of an equal mass of fluid moving with the velocity of the fluid, it will revolve with it; and it is plain that it cannot do so otherwise.

To apply this to our present case, we will divide the examples into two classes, viz., the same body dropped through different heights, and different bodies through the same height.

Referring to the figure, it is clear, if the path of the body be in vacuo, that if it be resisted in its tendency towards the earth's centre while the projectile force is the same, it must describe a wider orbit; and instead of taking a course BF, will describe a path BH, still, however, in the same plane, thus falling in a lower latitude. Now, the revolving air affords such a resistance; but besides this, from the first, it causes the body to partake somewhat of its rotation. Hence, in this case, it will move in a course BM, and will, consequently, fall in a higher latitude than if acted on by the central resistance only. But when the original projectile velocity is diminished by the friction, &c., to that velocity due to the body revolving with the air, it will revolve, and the deviation from the perpendicular must then have arrived at a maximum, and if measured by the angle subtended at the earth's centre, will remain the same through whatever space it falls after. The eastern deviation will be affected rather differently; for as soon as the projectile velocity decreases so as to be equal to that of the point A, it will have attained its maximum, and then diminish rapidly; since, after this, both the central resistance and the decreasing orbital velocity tend to reduce it, so that the body, after falling through a certain height, will not only lose what it first gained, but also its proper deviation, that is, the deviation it would have acquired in vacuo. Any distance through which it falls after this, must give a fast-increasing westerly deflection. If a heavy body fall through but a small height, it will not be subjected to the full effect of the air's resistance, on account of an insufficiency of time; but if a body of less weight be used, so that the force of the air may be more effective, the same action will take place as before, though a similarity will not be exhibited in the results. Suppose the body under consideration to be not greatly different in its specific gravity from air. The projectile velocity will evidently be very soon reduced to the velocity due to its rotation in air; for the force of the air acts more effectively on it, and the orbital velocity has to be diminished less than if it were a heavy body. A small height will thus give the maximum deviation from the perpendicular; and hence at a height not greatly different, this must be less than that of the plumb-line; for the deviation of the plumb-line increases as the height, while that of the body, after attaining its maximum, is constant, or at least sensibly so. It must, consequently, be expected that, with a height such as a quarter of a mile, or less, a very light body would exhibit a deflection north of the plumb-line; while a consideration of the eastern deflection will show that we might not expect this to be very different from the result which would be obtained in vacuo. At all events, it cannot diminish so rapidly as in the case of a heavy body, after obtaining its greatest amount. We are thus enabled to indicate the kind of effects produced in a series of experiments with bodies of various weights, sizes, and other qualities affecting their resistances, when dropped

through the same distance. If taken in the order of their resistances, commencing with the highest, it would probably be found that several would have the same north deflection, after which the succeeding ones should decrease until those having but small resistance exhibited south deflection from the plumb-line, the extreme limit of which must approximate to that given by Mr. Rundell in his paper, under the circumstances there mentioned. The effect on the eastern deviation cannot so readily be perceived without a few preliminary experiments. The variation in this, however, must be much less than that of the other.

In recapitulating, then, we find that falling bodies may have either north, south, east, or west deflection from the plumb-line; and that the first two deflections may be combined with either of the latter two, and that each may exist separately or not at all, depending on the circumstances of height fallen through, and the weight, size, and form of the bodies used.

W. SLOGGETT.

Devonport, June 24, 1848.

THE COMING COMET.—HISTORICAL NOTICE.

[From a Lecture upon the Science of Astronomy, delivered by Mr. Henry Althans, jun., before the Hackney Literary and Scientific Institution.]

On the 5th day of March, 1556, this eccentric wanderer was first perceptible in the sign of Libra. Pursuing its celestial course with great velocity, it touched the left wing of the sign Virgo, passed below the knee of the constellation Bootes, whence it ascended to the north pole of the ecliptic (its inclination being 32 degrees 6 minutes) towards Andromeda, where it lingered, but receding towards the Northern Fish, it was there lost. Its perihelion (or nearest point to the sun) was passed on the 21st day of April, just two days previous to its final disappearance. Whilst it remained within the circle of those tropical stars which never set, the comet was visible all night long; and throughout its course, the apparent magnitude of the head was uniformly as large as Jupiter to the naked eye. Its motion ran contrariwise to the succession of the Zodiacal signs, and within the space of four days, it completed seventy degrees westward, and thirty degrees northward, directing its path towards Saturn (then in Aries) but apparently slackening its speed as it approached that planet. At first its heliocentric motion was retrograde — at last direct. In the intermediate course it was most swift, despatching fifteen degrees daily. The nucleus (or body) presented the aspect of a bright globe of flame, equivalent to a half-moon, but the rays and colours varied and interchanged like the flickering of a flame agitated by the wind. The tail was moderately long and much attenuated; at first presenting a martial aspect, but subsequently dissolving into a pale and livid complexion: the stream of rays was denser near the head, and more rarified towards the extremity of the tail, which at first pointed eastward, but as the comet mounted to the north, the train took a southerly direction.

This eccentric member of the solar system has been conjectured to be identical with that mighty comet which startled Europe in the year 1264, so particularly described by Palæologus, Zuinger, Calvisius, Matthew Paris, and other chroniclers of the period. That portentous visitant was first discernible near the sign Taurus, behind the planet Venus; and it raged during the whole summer season, until the 7th day of October. It was originally observed in the twilight of the evening, but speedily passing the sun on the 6th of July, at a rapid rate, (the place of its perihelion being 21 degrees of Capricorn,) it re-appeared shortly before the morning twilight towards the 8th degree of Cancer, whence it retrograded very quickly into Gemini, threading its way between Canis and Orion, but ultimately retreating into the latter constellation. Its movement from east to west was more than equal to 50 degrees of latitude, and hardly 5 of longitude. The inclination of its parabolic orbit to the ecliptic was 36½ degrees; and the distance of its perihelion (that of the earth being 1) was 0·4450. At first it followed the morning star, but subsequently preceded that brilliant orb. The train or tail was very long and broad, resembling a fan in shape, emerging from the eastern horizon before the dimmer nucleus, and, when fully ascended, stretched itself upwards, and shooting its rays to the meridian, the comet occupied in length one-half of the heavens, presenting a fearful apparition to the eye of the superstitious spectator. As it swept along through space, the tail diminished daily in breadth, but proportionately increased in length and brilliancy. Contemporary historians relate many terrible calamities as befalling the nations of Europe during the year 1264; among other strange coincidences, it is related in the *Libri Chronicorum* (printed at Nuremberg, A.D. 1493,) and confirmed by other writers in the middle age, that on the occasion of the first appearance of this blazing star, the sovereign pontiff, Urban IV., was seized with an alarming distemper, which confined his holiness to his apartment during the entire period that the comet prevailed; and on the very night that the comet disappeared

the Pope expired. In 1556, its appearance was accompanied by similar strange sublunary events. The victorious emperor, Charles V., to the amazement of the world, suddenly resigned the crowns of Germany and Spain, and betook himself to a monastery, where he shortly died.

It was in a paper read before the Royal Society of London, about the middle of the last century (*vide Philos. Trans.*, vol. xlvii.), that Mr. Dunthorne hazarded the supposition that these two celestial strangers were identical — a conjecture also countenanced by the eminent French astronomer, M. de Lalande. This hypothesis has recently found a sanguine advocate in Mr. J. R. Hind, the discoverer of the new *asteroid*. But its return during the current year (1848), although endorsed by these high authorities, is very problematical; for the cautious Dr. Halley has expressly included the comet of 1556 along with five others concerning whose elements he was sceptical, as the observations handed down by Paulus Fabricius and the older astronomers (which formed the basis of his computation) were neither made with good instruments nor mathematical precision, so that great difficulty was experienced in harmonizing their conflicting accounts. Adequate allowance should also be made for the amount of the disturbing forces which this eccentric traveller may encounter through its approximation to other heavenly bodies in its lengthened journey through the realms of space. Besides, we possess exact details of its path only during one-fourth of the fifty days it was last visible. As for the elements of 1264, founded upon the Latin manuscript of a Dominican friar preserved in Pembroke-hall, Cambridge, they are open to grave exceptions, and form but a sandy foundation for the calculating astronomer of the nineteenth century. Is there not also a palpable difference of several degrees between the elements of the two? Considering, therefore, that the cometary revolutions are subject to extensive fluctuations, since these frail bodies are so susceptible of opposite attractions from powerful neighbouring orbs—weighing the difficulty of proving identity after a lapse of 292 years—and the laxity of previous observations;—above all, reflecting that the orbits of only *three* of these singular bodies are satisfactorily settled, whereas probably 800 appearances are known, and the elements of nearly 100 recorded;—may we not reasonably pause, and, with the sagacious Halley legitimately doubt, before yielding assent to a prediction, not wholly gratuitous, nor placed beyond the range of possibility, but yet depending too closely on conjecture, though seeking to ally positive calculation and observation in its support? But, in spite of mathematical discrepancies, imperfect instruments, and conflicting *data*, should the approach of this comet crown the other wonderful occurrences of this eventful year, it will afford another astronomical triumph; as the comet will then have completed its twentieth revolution round the sun since the creation of the world.

CAPTAIN SPIKE'S METHOD OF RAISING SUNKEN VESSELS.

Sir,—I am anxious to make some remarks upon the subject treated of in your last number, by your correspondent who signs himself "A Landsman." The mode of raising the vessel by Captain Spike is perfectly possible, simply on the supposition that she had no scupper-holes. In such a case, the water outside would not be in free communication with that within her bulwarks, and, consequently, the holes alleged to have been bored would have had the effect attributed to them. You will observe, then, that I would qualify the statement in your editorial note, in so far as respects the assertion that the feat in question could "never have been accomplished under any possible state of circumstances."

The question between your correspondent and his friend is one of fact—"Were there scuppers or were there not?" and in default of positive evidence, I think we shall find the general appearances to be against the assumption of "A Landsman."

1st. Very few decked vessels have no scuppers.

2nd. Especially if deep in the waist.

3rd. The captain leads us to infer that there were scuppers, else it would have been unnecessary to caulk the main-hatch, or even to close it. At the same time, it may be urged that there is no mention of scuppers at all, as remarked by your correspondent; and that the combings of the main hatch were unusually high for a vessel with great sheer and scuppers.

And, lastly, had there been scuppers, the fact of any water running from holes bored as stated, must have been not real, but invented quite gratuitously.

I am, Sir, yours, &c.,
JOHN MACGREGOR.

24, Lincoln's-inn-fields,
June 27, 1848.

[We insert this letter out of respect to our esteemed correspondent, but cannot say, that we are at all shaken by it, in our conviction of the soundness of the opinion we have expressed. Scuppers or no scuppers, there was, at all events, a free communication, through the main-hatchway, be-

tween the water outside and inside; and, we repeat, that as long as that was the case, there could be but one water-level common to both.—Ed. M. M.]

CIRCULAR SAWING.

An experiment was, by permission of the Lords Commissioners of the Admiralty, made at the Saw-mills, Woolwich Dockyard, on Saturday last, by Mr. James White, C. E., with the view of testing the efficiency of circular saws in cutting through the centre of rough timber of a diameter nearly equal to that of the saw itself.

An elm tree—one end of which was of the full diameter of the saw—was placed upon one of the circular sawing machines, having a saw 4 feet diameter, and a self-feeding motion, in the usual way. By this motion the tree was brought towards the saw, and passed over it; and by a reverse motion, it was run back.

The cut made in the tree, passing over the saw, was in dead wood all the way, and fully 20 inches deep. After the tree was run back, it was turned over, and adjusted for a second cut to line with the first; and in this position it was brought forward, as before, and completely divided in two.

The object of this experiment was to ascertain whether rough timber of a large size can be cut up in this way, and the result was quite conclusive in that respect.

Lord Willoughby de Eresby was present, and took much interest in the experiment. It is now his lordship's intention to adopt circular sawing for cutting up the timber upon his estate, either in the way described, or by placing (as suggested by his lordship) one saw above the other, and dividing the tree at one cut, to avoid the trouble of turning the tree over.

MALTBY AND WEBB'S PATENT IMPROVEMENTS IN DISTILLATION.

[Patent dated December 15, 1847. Patentees, William Maltby, of Tredegar-square, and Thomas Webb, of Mare-street Hackney. Specification enrolled June 15, 1847.]

The improvements described in this specification relate,

Firstly. To the preparation of grain prior to the employment of it for brewing or distilling.

Secondly. To the addition of tartaric or citric acid to the wort, or other saccharine solutions.

Thirdly. To the retaining of the products or gases evolved during the process of fermentation, and causing them to return into the solutions, in order to promote the said process.

Fourthly. To the peculiar construction and arrangement of apparatus, whereby the distillation is more rapidly and continuously effected, and the temperature of the alcoholic vapour so regulated, that spirit of almost any desired strength may be obtained.

When the patentees operate upon barley, they submit it to heat until it is deprived of about 12½ per cent. of its weight, taking care not to burn the grain; they then grind it, add, when cold, 8 per cent. of its original weight of malt, and continue the brewing process after the usual manner. Next they mash it in a mash tun for half-an-hour, and mix with it 4 lbs. of soda of commerce dissolved in water to every one quarter of barley which has undergone the preceding process, (should it not have undergone that process, 3½ lbs. of soda will be sufficient.) When the temperature of the wash has sunk to 80° Fah., yeast is added, to produce fermentation, the fermenting back is closed, the refrigerator half filled with water, adding soda thereto, and the fermenting liquor stirred, by means of an agitator, every five or six hours, until its specific gravity is equal to or less than water. The patentees then mix with the wort or solution catechu, concentrated sulphuric acid, or other acid, in sufficient quantity to neutralise the soda. The wort, or wash, is now ready for use.

Instead of adding the soda as before stated, a portion of the water in the refrigerator may be used, provided that it contains the requisite quantity of soda.

When sugar is employed for the purpose of distilling spirit therefrom, a 100 lbs. of sugar are mixed with 100 gallons of water, adding 2 per cent. of yeast to cause fermentation, and then soda, or carbonate of lime, and afterwards catechu, concentrated sulphuric acid, or acetate of lead, in sufficient quantity to neutralize the soda or carbonate of lime.

When molasses are employed, the same methods as in the preceding case are adopted. When it is desired to obtain a very fine but peculiar spirit, the patentees add ¾ lb. of tartaric or citric acid (or the parts of those fruits which contain them), to every 1 cwt. of saccharine matter contained in the solution, and omit the use of soda or carbonate of lime.

The apparatus referred to under the third head consists of a fermenting back, through the centre of which passes a horizontal

shaft furnished on the outside with a handle for communicating motion. On the shaft, and inside the fermenting back, are fastened two fans, so that the one shall be in the same right line as, and a continuation of the other. These fans are divided into cells by a number of ribs attached to those two of their four surfaces which come in contact with, and do not recede from, the liquor. In or near to the centres of every other one of these cells, is a hole for the purpose of allowing the passage of the carbonic acid gas. Communication is established between those cells which have holes and those which have not by means of channels in the ribs. Above, and on one side of the fermenting back, is placed the refrigerator, in which is a worm or a coil of pipes communicating with the back. Communication is established between the refrigerator and the mash tun, and also between the latter and the fermenting back.*

The apparatus for distilling by means of steam or hot water, consists of the body of an ordinary still of either wood or metal, in which are placed shelves one above, and equidistant from each other. Upon the top surface of each shelf is formed a channel, open at top, of a convolute form, in which is placed a worm. The channels and worms on each shelf communicate one with the other. The wash which enters the still at top, circulates through the channels on each shelf successively, and in so doing comes in contact with the exterior surfaces of the worm, in which circulates steam (admitted at the bottom of the still) whereby it is heated, and the alcoholic vapour disengaged. In the head of the still is a worm, through which flows a stream of cold water, to be regulated at pleasure; and between the body and head of the still is a perforated plate for the purpose of spreading the alcoholic vapour which, passing upwards and round about the worm, becomes by its contact therewith, cooled. The alcoholic vapour then passes into a receiver, and subsequently through other refrigerators to be properly condensed. The patentees state, that by these means for regulating the temperature of the alcoholic vapour, they are enabled to obtain spirits of almost any required strength.

The patentees describe further, an arrangement for applying the used steam and waste wash to the heating of the wash previous to its entry into the still, and also an apparatus for straining it in its passage thereto.

* Although neither the object of this arrangement of apparatus nor the mode of working it is described in the specification, it is presumed that the carbonic acid gas is to be caused to escape through the worm into the atmosphere, while any alcoholic vapour which might accompany the gas would become condensed in the worm, and so return into the back in a fluid state.

DUNN AND ELLIOTT'S MACHINE FOR TESTING CHAIN CABLES.

Messrs. Dunn and Elliott, of the Windsor-bridge Iron-works, Manchester, have lately invented a machine for testing chain cables, which is distinguished by great simplicity in its arrangement, and by which some important objects are more completely attained than by any previous invention. The machine has been made for Messrs. Hingley and Sons, of the Cradley Chain-works, Worcestershire, and of Salthouse Dock, Liverpool. Hitherto those gentlemen, and other chain-cable manufacturers, have not possessed on the spot a sufficiently powerful testing machine; and if their cables broke when tested at Liverpool, they suffered all the cost of the carriage of the cables thither, and the expense of repair. This disadvantage is now obviated, and a perfect test of each chain will be made where the article is manufactured. Messrs. Dunn and Elliott's machine was tried at their works (the Windsor-bridge Iron-works) previously to its being sent to its destination, in the presence of Mr. Fothergill, of the firm of Roberts, Fothergill, and Dobinson; Mr. W. Mayburn, of the Ardwick Iron-works; Mr. Barlow, consulting engineer; Mr. Booth, manager of Messrs. Whitworth and Co.'s works; and other engineers and machine makers. The opinion of these gentlemen was highly favourable to its merits. The machine in question consists of a horizontal iron cylinder, 6 feet long, in which works a piston. At the end of the cylinder, and continuing in the same right line, is an iron trough, or pipe, which may be lengthened or contracted at pleasure. At the end of this trough are a pair of iron claws, to which one end of the chain to be tested is fastened; the other end of the chain is fastened to the end of the piston-rod, by similar claws. The chain being thus fixed, is tested in the following manner:—Water is forced by a double hydraulic pump into the cylinder, between the bottom of the piston and the water-tight end of the cylinder next to the trough, which, of course, forces the piston to descend the cylinder, stretching and severely testing the chain, one end of which is attached to the piston-rod. The advantage of testing the chain by means of a hydraulic pump, over any other means of testing hitherto adopted, is, that a more gradual and constant increase of pressure is obtained; and that, on account of the slightest elasticity of water, there is

not the severe rebound which, on other arrangements, takes place when a heavy chain is broken at a very high pressure, and which is sometimes attended with serious injury to the testing machinery, and with dangerous accidents to the bystanders. The trough by which the chain is being tested is shut in, which is a further precaution against accident. The adaptation of the hydraulic press to the purpose in question was not, however, a novelty. The peculiar advantage of the new machine is the combination of the hydraulic press with a simple and effectual contrivance for accurately registering the pressure exerted upon the chain, which we shall now describe. At the end of the cylinder, next the trough, and in its upper surface, is fixed a brass ram, working in a water-tight stuffing-box, and having its upper end connected with a scalebeam. The scalebeam, of course, rests on a support fixed upon the machine. When, therefore, the water is forced into the cylinder, the ram, it is clear, must be driven upwards, lifting the scalebeam with it; and, by fixing different weights upon this, or sliding the same weight nearer or further from the fulcrum of the beam, as on a steelyard, the intensity of the pressure can be accurately measured. The gradual increase of weight arising from sliding the weight along the beam, combined with the gradually increasing pressure from the hydraulic press, gives, it will be at once seen, a total freedom from jerking, or from sudden straining in the testing. In order to get rid of the necessity of entering into minute calculations, as to the effect of the weight of the scalebeam, or the friction of the ram in the stuffing-box, the scalebeam is lengthened beyond the pivot, its two limbs being made to balance; and upon the limb on which the ram does not act, and upon which the testing weight or weights are not placed, a small weight equal to this friction is placed. In the cable-testing machines to which the hydraulic pressure has hitherto been applied, the lever for measuring the pressure has been annexed to the pump; and consequently one most important element in the calculation, the friction of the water in the pipe from the pump to the cylinder, and in the cylinder itself, has been totally omitted, or, at all events, has not been measured with the slightest approach to accuracy. The weight of the whole machine, not including the trough, is about 3 tons, its width about 5 feet; the length, of course, is variable, depending upon the length of the chain which is being tested. It is capable of testing with any pressure, from ½ cwt. to 100 tons; its cost is only about 200*l*. The corporation machine at Liverpool, whose testing power does not exceed that of Messrs. Dunn and Elliott's machine, cost 1000*l*., and is about six times the weight and three times the bulk of the machine we have been describing.

The above machine has been proved at the Cradley Chain-works. A chain cable, 30 yards long, made from 1¾ rounds of the regular quality of cable iron, by S. Evers and Sons, bore the extraordinary weight of 78 tons, being 28 tons above the regular proof required at Lloyd's, and stretched 4 feet in length before it could be broken, the power of the machine literally dragging the iron asunder.—*Birmingham Journal.*

THE WOOD PAVING PATENTS.

Court of Queen's Bench.—June 26, 1848.

(Before Mr. Justice Wightman.)

Hulse and Others v. *Esdale and Others.*—This was an action brought for an infringement of a patent for wood pavement, and breach of covenant. It appeared that several patents had been purchased by the plaintiffs to secure to themselves the right of using wooden blocks for the purpose of pavement. It further appeared that in the specification of one of these (Parkyn's) it was stated that the fibres of the wood should lie at an angle of from about 45 to 70 degrees. The defendants had taken a license from the plaintiffs to use Parkyn's invention, but they had deviated from it so far as to lay the blocks (at Cornhill and Chalk Farm) at 73 degrees of inclination. The plaintiffs now claimed at the rate of 6d. per square yard,—50*l*. 1s. This demand was resisted, on the ground that what they had done did not come within the deed of license, which stated the limits to be between 45 and 70 degrees.

The learned judge said, that as the agreement was that the wood pavement, for which the defendants were to pay, distinctly stated that the inclination of the fibre should range between 45 and 70 degrees, both parties were bound by that agreement.

The jury, therefore, under the direction of the learned judge, returned a verdict for the defendants.

The jury stated, however, that they considered the principle to be the same.

Note.—The patent of Mr. Parkyn formed the subject of a former judicial investigation, the result of which was equally unfavourable for its proprietors.—See report of Parkyn *v.* Harrison, *Mech. Mag.*, vol. xxxii., p. 353. The Vice-Chancellor in that case decided against the patent, because the words "from about 45 to 70 degrees" were not sufficiently definite; while the patent on which the then defendent relied (that of Count de Lisle) was good, because he bound himself to the precise angle of 63°, 26′, 5″·8. A correspondent (same vol., p. 741,) observed on this that the *practical* effect of that decision would be to upset both patents; for if the one was *legally* bad for its indefiniteness, and the other only legally good because it is so wonderfully precise, then it must be open to all the world to use other angles as near to the specified angle as might be, as long as they were not identical with it; "for angles of five degrees on either side of the patented one will make pavements just as good as it will." The view taken by our correspondent is strikingly confirmed by the result of the present trial.—Ed. M. M.

NOTES AND NOTICES.

Magneto-Plating.—In our last number we stated that magneto-plating was the invention of the "*late Mr. Woolrich*," of Birmingham. We find that we were in error in this respect, and that his son, Mr. John Stephen Woolrich, was the real inventor and patentee—the same gentleman of whom we spoke as now carrying on the invention. The late Mr. Woolrich was probably the first person who deposited metals for any practical purpose by means of the galvanic battery; but the magneto process was entirely his son's own invention.

Spontaneous Combustion.—The American papers mention the loss by fire, occasioned by spontaneous combustion, of the brig *Canning*, at Port Famine. She was laden with nitrate of soda. The layers of bags which contained the soda, on being reached by the fire, exploded in succession, with reports resembling the discharge of artillery.

New Screw Cutting Machine.—A plan of cutting iron screws is stated to have been invented by P. W. Gates, Esq., of Chicago, Illinois, by which the power of one man will cut per day, 700 half-inch, 500 three-quarter inch, 400 one inch, and 300 one and a half inch bolts. The advantages claimed for this plan over the common die, are its despatch in doing work; its durability, having cut over 4000 bolts with one die, without any repairs; instead of jamming or driving the thread into shape it cuts it out, the same as in a lathe, leaving the thread of solid iron, which cannot be stripped off as is usual with those cut by the common die, and it will do the work by once passing along the bolt, making the thread perfect. The die, it is said, can be made by ordinary workmen, with far less expense than the common die, and when made, is not at all liable to get out of repair.

The Inventor of the Tubular Bridges.—A controversy has sprung up as to the respective claims of Mr. Fairbairn and Mr. Robert Stephenson to the high honour of having first originated the idea of the tubular bridges. Mr. Bateman has appeared as the warm partisan of Mr. Fairbairn, and insists that Mr. Robert Stephenson played only second fiddle to him. Mr. Stephenson thus vindicates his own claims in reply:—"My attention having been drawn to a letter from Mr. Bateman on the subject of the tubular bridges at Conway and the Menai Straits, of which the merit is, without scruple, arrogated to Mr. Fairbairn, I beg to annex an extract from a letter to me from the latter gentleman, dated the 27th of October, 1846:—'I am much obliged by your letter of yesterday, and especially that part of it which relates to the original idea of the bridge. *I am sure it was yours in every respect;* but there is nothing new, or likely to turn out valuable, but there immediately start up a hundred claimants. We are all subject to this mental encroachment; but in your case everything is now clear. At all events, you may rest assured of my best efforts in supporting the claim to which you are so justly entitled.' This extract shows sufficiently Mr. Fairbairn's feeling at the time when his letter was written, which was subsequent to the passing of the Act; and I will only add to it, that I have never attempted in any way to detract from the merits of any party connected with the work, but have always freely acknowledged the valuable assistance which has been afforded to me during its progress by Mr. Fairbairn, Mr. Hodgkinson, and Mr. Clark; but that Mr. Fairbairn devised, or had charge of the entire construction, is simply a misstatement of facts. He, in common with the other two gentlemen named, aided me by his advice, and I acted upon it, or otherwise, as I thought proper. The company looked to me as alone responsible; and in my discretion every other party who has been concerned in the progress of these bridges was engaged.—ROBT. STEPHENSON."

Pension to Mr. J. P. Adams.—A pension of £200 per annum has been most deservedly conferred by Government on Mr. Adams, the English discoverer of the planet Neptune.

Gutta Percha.—The trade in this article seems to be advancing in importance every day, and to be engrossing the attention of the natives of the Indian Archipelago, to the exclusion of other pursuits. The quantity imported into Singapore in the first four months of this year, according to the official reports, was upwards of 700 piculs, equal to 820 cwts., which is, however, short of the actual supply. The price had risen from 12 dollars to 20 dollars. It is said that the American Langat Tin Company have secured the monopoly of the gutta of the Salangore territory for two years, for the sum of 30,000 dollars.

Public Passenger Time-Signal for Railway Stations.—A great want has long been felt for some certain and effective means of informing or *warning* the public of the approaching departure of passenger trains. Bells rung within or near the station cannot ensure this purpose, the sound being easily stifled, and apt to be regarded, besides, as a nuisance. Clocks are still more useless, as they are visible only at short distances, even where they can be placed in conspicuous positions. The requisite machine, we are happy to say, has now been devised and brought into successful operation. It consists simply of a lofty pillar, with a moveable ball, which drops, within a limited space of time, from the top to the bottom, and, as it descends, indicates exactly the time which is to elapse before the train sets off. Being a most conspicuous object, it is distinguished at a considerable distance by intending passengers, who are thereby saved all unnecessary hurry and excitement in making their way to the station. The North British Company have erected one of these signals at the Portobello Station; and we understand that it has proved a great comfort and relief to the inhabitants. Every station of any importance ought to be provided with a similar apparatus, the cost of which is insignificant, considering its real and constant utility, and the prevention of annoyance, both to the company's servants and the public, which it secures. We are sure that the least of the inventor's objects is the mere pecuniary profit which may accrue from this ingenious instrument, and we have therefore the less hesitation in calling the attention of railway managers to its undoubted merit and usefulness.—*Scottish Railway Gazette.*

An Expansible Currency.—One dollar bills of the New Haven County Bank, U. S., are issued, composed of paper made of India-rubber. This is the most expansible kind of paper currency known, and is admirably adapted to such banking institutions as desire to "stretch their credit."—*American Paper.*

The Carpet Manufacture in America.—The most extensive manufactories in the United States are at Thompsonville; they use 10,000,000 lbs. of wool, and 10,000 lbs. of flax yarn per annum. They manufacture three-ply Brussels and, Axminster carpeting of the richest patterns, the weaving being mostly done at present on hand looms, they are, however, about introducing power looms into this factory for weaving rugs and Axminster carpets. The wool for Axminster carpeting is first woven in a web, and afterwards cut in strips forming what is called chenniele card; this is done upon a machine invented by Messrs. Davidson and Parks, of Springfield, Vermont, which is the first and only one of the kind in the United States, and has more than paid for itself in six months. This machine has over 200 cutters, or knives, which are attached to a cylinder, making some 300 revolutions, and cutting full two yards of the web per minute into strips, which being passed over a grooved cylinder heated by having hot irons inserted within it, it is prepared for weaving. Besides the large carpet establishment, there is in this village a factory 150 by 43 feet on the group, and five stories high, for the manufacture of knit shirts, drawers, and fancy ginghams, this establishment has about 30 sets of wool cards, and 25 or 30 gingham looms.—*Scientific American.*

Softening Ivory.—"Can you inform me of any method of softening ivory? There was a person in Sheffield, about twenty years ago, who discovered a method of rendering ivory sufficiently soft to take any impression; but whether he ever patented it or not, or whether it was ever published, I cannot tell. He is now dead, and the process appears to have died with him. It has been stated in the *Family Herald*, 'that dilute nitric acid has the property of softening ivory;' but I think this is a mistake. I have tried it in various ways, but can make nothing of it. If you could put me in the right way, I should feel extremely obliged.—Y. X., Sheffield."—Ivory may be softened by any caustic alkali, but not so as to be of any use afterwards. To soften is, in fact, to decompose and destroy it. According to all past knowledge and experience, it does not admit of being either moulded or embossed, like horn and tortoise-shell; and we very much doubt, therefore, the correctness of our correspondent's story about the man in Sheffield and his lost secret.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Deane Samuel Walker, of London-bridge, merchant, for improvements in the manufacture of band or straps for hats, caps, shoes, and stocks. June 24; six months.

Henry Archer, of Shaftesbury-crescent, Pimlico, Middlesex, gentleman, for improvements in matches and in the production of light, and in the apparatus to be used therewith. June 24; six months.

William Hunt, of Dodderhill, Worcester, chemist, for improvements in obtaining certain metals from certain compounds containing these metals, and in obtaining other products by the use of certain compounds containing metals. June 24; six months.

Richard Clark, of the Strand, Westminster, lamp manufacturer, for certain improvements in gas-burners, and in candle-lamps and other lamps. June 26; six months.

Frederick William Mowbray, of Leicester, paper dealer, for improvements in the manufacture of looped fabrics. June 27; six months.

John Macintosh, of Glasgow, gentleman, for improvements in obtaining motive power. June 28; six months.

Joseph Skerthley, of Anstey, Leicestershire, gentleman, for improvements in bricks and in the manufacture of tobacco-pipes and other like articles. June 30; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
June 22	1478	Thomas Lopling	Bishop Wearmouth, Durham	Mangle.
23	1479	John Paterson,	Cheapside	Waist belt.
,,	1480	Woods and Thomas	Cheapside	Rotary postage stamp and gum ticket damper.
28	1481	Frederick Harris	Wood-street	Ticket pin.

CONTENTS OF THIS NUMBER.

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MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

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THE MODEL PRISON SYSTEM OF VENTILATION AND WARMING.

Fig. 5.

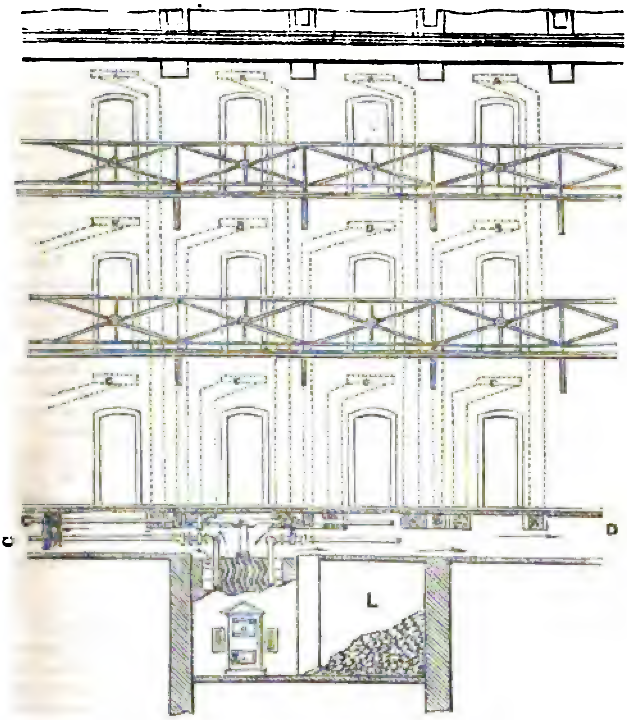
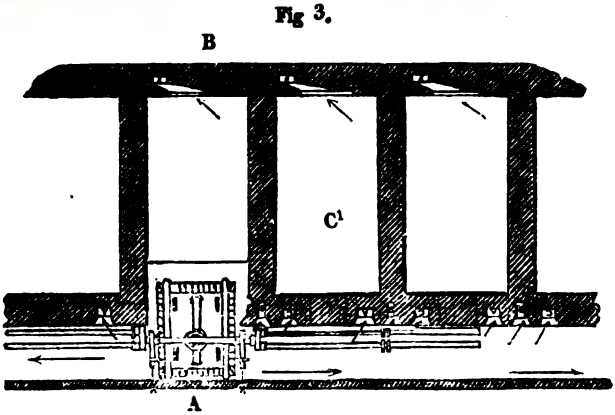


Fig 3.



DESCRIPTION OF THE SYSTEM OF VENTILATION AND WARMING ADOPTED AT THE MODEL PRISON, PENTONVILLE.

[From Report of Lieutenant-Colonel Jebb, R. E., Surveyor General of Prisons.]

Ventilation.

"The ventilation of a cell cannot fail to have a direct influence on the health of a prisoner, and it is therefore one of the most important objects connected with the construction of prisons.

The necessity of resorting to an artificial system for a regular supply of fresh air at all times and seasons will be apparent when it is considered that, in order to prevent communication between prisoners in adjoining cells, it is necessary that the windows should be fixtures, and the doors generally closed.

The main objects to be attained may be thus stated:

1st. The withdrawal of a stated quantity of foul air from each cell.

2nd. The supply of an equal quantity of fresh air into each cell without subjecting the occupier to the prejudicial effect of a draught.

3rd. The means of warming the fresh air when necessary, without injuring its qualities or affecting its hygrometrical condition.

4th. That no additional facilities for the transmission of sound should be afforded by the air-channels or flues.

The general disposition of the flues and apparatus for effecting the several objects proposed will be best understood by referring to the accompanying figures.

An apparatus for warming the air, when required, is generally placed in the centre of the basement story. This apparatus consists of a case or boiler, to which a proportion of pipes, adapted for the circulation of hot water, are attached. In connection with it there is a large flue open to the external atmosphere.

The fresh air introduced through this opening, after passing over the surface of the boiler, turns right and left along a main flue, CD, which runs horizontally under the floor of the corridor, and from thence passes upwards through small flues, A, B, C, preserved in the corridor wall, which terminate respectively in a grating placed close under the arched ceiling of each cell on the three stories (see figs. 2, 3, and 5.)

A current of air may thus be introduced from the exterior into each cell; and it is obvious that it may be warmed or left at its natural temperature, as circumstances require.

This channel for the introduction of fresh air would, however, be of little avail in furnishing the supply required, unless corresponding arrangements were made for extracting the foul air from the cells, which, under ordinary circumstances, is the first movement that will take place. The disposition of the flues and shaft for this purpose will be noticed in the figures.

A grating is placed close to the floor of each cell, on the side next the outer wall, and diagonally opposite to the point where the fresh air is introduced (see D, E, figs. 1* and 4.) This grating covers a flue in the outer wall, opening at its upper extremity into a horizontal foul-air flue in the roof, which communicates with a vertical shaft raised 20 or 25 feet above the ridge.

It will thus be seen that a communication is established first from the outer air through the warming apparatus to the top of each cell, and thence from the floor of each cell upwards through the extracting flues and ventilating shaft into the outer air again. By this arrangement the total lengths of each pair of flues respectively made use of for extracting foul air from the cells, and introducing fresh air into them, are rendered nearly equal on all the stories—thus promoting uniformity of action.

Objections may be urged against the principle of making the point of entry of the fresh air at the top of the cells, and extracting the foul air from the lower level, and, as an abstract matter of science, it may possibly be a question whether this order should not have been reversed.

Dr. Reid's opinion on the subject is thus stated in a letter to Viscount Duncannon, with reference to the arrangements for ventilating the House of Commons.

"The air may be made to *descend* from the ceiling, and be removed by the floor. I know no method that combines *so many and so numerous advantages* as this. Experience has assured me that there is no method at all comparable to the *descending atmosphere* for the House of Commons. Even the suspicion of dust would not then annoy the members. The air can be admitted at any temperature, its first impulse being *softened by the air on which it falls*."

When, however, it is considered that the cells contain 800 cubic feet of space, and are occupied by only one individual; that a ventilation of from 30 to 40 cubic feet per minute has been secured, at a cost during the winter months of less than a farthing per cell, and during the summer at half that expense; and that a perfect diffusion of air takes place within the cell; it will be appa-

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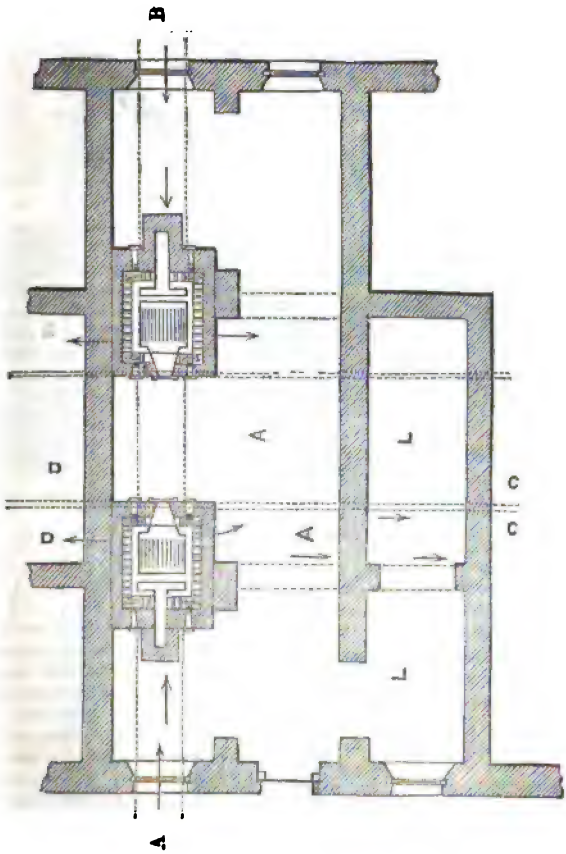
* Fig. 1 will be given with the continuation in our next.

rent that there is no object in sacrificing other important and practical considerations to any refined reasoning on that point.

It will be seen, also, that the *ascending* principle of ventilation of the entire system is preserved, and that the extraction of foul air from the cells is partly to be referred to the superior altitude of the extracting flues and shaft, which are in and above the roof. If the foul air were required to pass *downwards*, *below the floor* of the cells, into flues situated in the basement, a power must be maintained in constant operation to overcome the tendency of air at a higher temperature to remain at a higher level. The ventilation in such a case would

Fig. 2.



be entirely *forced*; whereas, by the arrangements which have been described, it only requires to be *assisted*. From the diffusion which takes place, the difference of temperature at the ceiling or floor of a cell can scarcely be detected, and will seldom exceed one degree; and it may be inferred that the difference of power required for extracting the air at one or other of those levels would be inappreciable. But even if it led to an increased expense in the consumption of fuel, it would be an object to check the rising of dust, and to secure the advantage of introducing the air at a point

not easily accessible to the prisoner, and from which he would not be likely to experience any inconvenience.

Among other reasons, it may be stated that the effect of introducing the air at a low level would be, that when the fires were not lighted, the prisoner would be sensible of the draught of cold air, and would devise some means of stopping up the grating; and during the cold weather when the air would be warmed, he would probably sit or lie down close to it, and be enervated by its effects.

Having thus given a brief and familiar explanation of the principle applied, and the disposition of the flues for ventilation, the application of the motive power, by which the regular abstraction of the foul air from

Fig. 4.

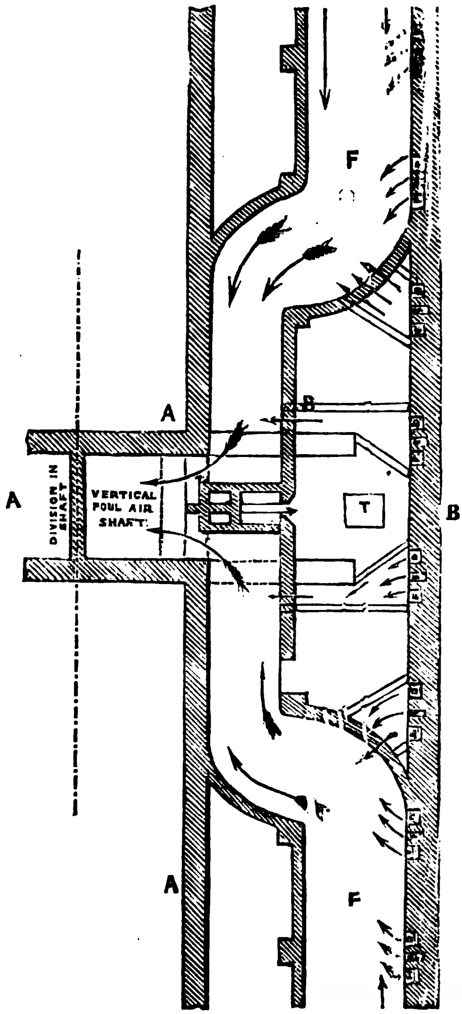
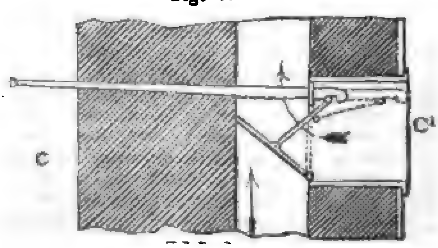
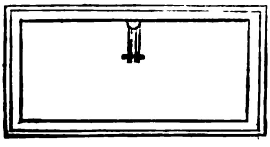


Fig. 6.



the cells, and a supply of fresh air in its place, is insured, will be easily understood.

Fig. 6a.



The main flues in the roof intended for the extraction of foul air from the cells, are connected with the vertical shaft which appears in the section, fig. 1. During the summer months a small fire is maintained at the bottom of this shaft, which raises the temperature of the column of air within it above that of the external atmosphere, or the general temperature of the cells, and thereby causes it to be specifically lighter.

Fig. 7.

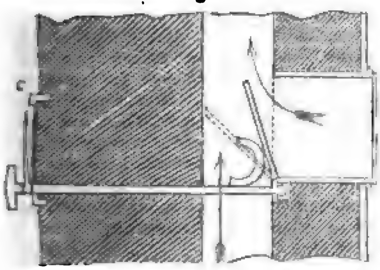
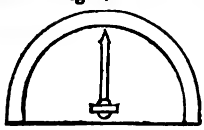


Fig. 7a.



In this state it naturally rises, and the partial vacuum thus formed is filled from the adjoining foul-air flues. These main flues derive their supply directly from the cells, and the cells receive through the proper channels a corresponding supply of fresh air to replace the foul air which has been abstracted by the vertical shaft.

The quantity of foul air withdrawn from the cells will mainly depend upon the proportionate temperature maintained in the ventilating shaft. Under ordinary circumstances, if an average difference of from 5° to 10° above the external temperature be maintained, it will be found sufficient to produce the desired effect. The consumption of fuel for this purpose at Pentonville prison has been about one hundred weight per diem for one wing, containing 130 cells, it having been the practice to light the fire, of which there is one on each side of the corridor, on alternate days. The cost of effecting the summer ventilation of one wing, at the present price of fuel, has been about fifteen pence per diem, or about one-eighth of a penny for each cell.

During the winter months, when the fires are lighted in the apparatus below, the smoke and disposable heat being thrown into the ventilating shaft above the upper cells, will generally be found sufficient to secure an effective ventilation, and no further trouble or expense is necessary.

The principle on which the ventilation is effected is similar to that in operation in mines, the ventilating chimney being substituted for the upcast shaft. There are, however, greater facilities for maintaining a current of air through any given channels above ground, than can possibly exist in the extended and complicated galleries of a coal field, situated many hundred feet below the surface.

In the foregoing explanation it has been assumed that the atmosphere, both within and without the prison, is stagnant, and no allowance has been made for the advantage derived from the pressure of the air at the point where it enters the flues, which, even in a moderate breeze, has a very favourable influence in producing a more active circulation. These combined causes, though they cannot, of course, always be depended on for producing ventilation, will greatly assist it, and the action of a very moderate fire will, under any circumstances, ensure it.

Description of the Figures.

Figs. 2, 3, 4, and 5 show the system of ventilating and warming now actually in operation at the Model Prison, and which has been successfully adopted in all the principal prisons lately erected under the authority of the Secretary of State.

Fig. 2 is a plan of the basement; fig. 3, a grand plan; fig. 4, a plan of the roof; and fig. 5, a longitudinal section of part of the corridor.

P is the apparatus room.

A, fresh-air flues, open to the external atmosphere.

C D, fresh-air flues.

A^1, B, C, small fresh-air-flues.

C^1 C^1, cells.

F F, foul-air flues.

M F, main foul-air flues.

S S, smoke flues.

F S, foul-air shaft.

R, corridor.

L L, places for coal.

T (fig. 3) trap.

Fig. 6 represents the details of a regulator, as fixed at Pentonville, by which a prisoner is enabled to admit warm air from the main flues, or cool air from the corridor. C^1 is the corridor; C, the cell.

Fig. 6^a is an elevation of the regulator, as seen in the corridor.

Fig. 7 represents a contrivance for the same purpose, which has been adopted at Kirkdale; I P is the index-plate. Fig. 7^a is an elevation of this regulator, as seen in the corridor.

Fig. 8 shows the means by which cold air may be admitted into a cell from the exterior, and also a plan for increasing the ventilation of a cell during summer. F is the floor; C, the corridor; C L, cell; A, fresh or warm-air flue; H, arch; I, foul-air flue; B, external air-brick; G, air grating, with wood slide for summer use: G^2, a second grating for same purpose.

(To be continued in our next.)

METHOD OF WELDING IRON, STEEL, AND SHEET IRON.

In an earthen vessel melt borax, and add to it one-tenth of sal-ammoniac. When these ingredients are properly fused and mixed, pour them out upon an iron plate, and let them cool. There is thus obtained a glassy matter, to which is to be added an equal quantity of quick lime.

The iron and steel which are to be soldered, are first heated to redness, then this compound, first reduced to powder, is laid upon them; the composition melts and runs like sealing-wax; the pieces are then replaced in the fire, taking care to heat them at a temperature far below that usually employed in welding; they are then withdrawn and hammered, and the surfaces will be found to be thus perfectly united. The author asserts that this process, which may be applied to welding sheet-iron tubes, never fails.

METHOD OF BRINGING OUT SCULPTURE UPON ALABASTER.

This process is founded upon the property which alabaster or sulphate of lime has, of being slowly eaten out by cold water, so that its polish is destroyed.

In the first place the sculptures in relief, and all the parts intended to be preserved, are covered with a varnish insoluble in water, composed of wax dissolved in oil of turpentine mixed with white lead, or rather with a turpentine varnish, to which white lead and a little animal oil has been added to prevent the varnish from hardening and adhering too strongly to the alabaster. This is applied with a soft paint brush moistened with oil of turpentine, into which it must be dipped every time that varnish is taken. The reserved parts being thus covered, suffer the vessel or ornament to dry for some hours, and then place it in a vessel filled with cold water, and leave it there for forty-eight hours, or longer if it is thought necessary. The varnish is then removed with a fine sponge dipped in oil of turpentine, and the vessel dried with a soft and very dry rag. When the vessel is thus cleared of its varnish and dried, pass over it a new soft brush, first dipped in finely powdered plaster. This powder fills the pores of the plaster which has been attacked by the water, and renders it mat; which brings out the transparent parts of the alabaster in relief.

To clean ornaments and sculptures in alabaster.—Wash out any grease spots with oil of turpentine; then put the piece in water, and suffer it to remain until it is freed from its impurities. When you take it out, rub it with a very dry paint brush; let it dry, and pass over it powdered plaster. In this way the piece will be perfectly washed, and will look as though it had just come from the hand of the carver.

ON A CERTAIN ARABIC MANUSCRIPT. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

Sir,—In Hutton's *Philosophical and Mathematical Dictionary** allusion is made to "an Arabic manuscript, said to be on cubic equations, deposited in the library of the University of Leyden by the celebrated Warner, bearing a title which in Latin signifies *Omar Ben Ibrahim al' Ghajamæi Algebra cubicarum æquationum, sive de problematum solidorum resolutione.*" The importance of ascertaining the nature of the manuscript alluded to is great and obvious. It would probably clear up some doubtful points in the history of algebra. I address this note to you in the hope of being the means of inducing some competent Arabic scholar to examine the supposed manuscript with the attention which it appears to deserve.

I am, Sir, yours, &c. JAMES COCKLE.

Northampton, June 30, 1848.

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* See vol. i., p. 74, art. "Algebra."

RECENT AMERICAN PATENTS.

[Selected from the *Franklin Journal.*]

IMPROVEMENT IN CLOCKS AND TIME-PIECES. *Chauncey Boardman and Joseph A. Wells.*

The invention consists in placing the driving spring upon the same shaft with the fusee, connecting the shaft of the combined fusee and spring to the frame of the clock movements, and attaching one end of this spring to the frame of the clock movements.

IMPROVEMENT IN TOASTING COFFEE, CALLED "SELF-TOASTING AROMA-CONDENSING APPARATUS." *John R. Remmington.*

The patentee says, "The nature of my invention consists of a metallic wheel of buckets, somewhat similar to an overshot water-wheel, but of small diameter, the buckets of which receive the grains of coffee that drop one by one from a hopper above, and which by their weight, turn the wheel that carries the grain slowly through a circular trough below, that extends around about one-third of the circumference of the wheel, and which is sufficiently heated by a small furnace to toast the coffee during the time that it is carried from one end to the other, when it is discharged by means of an inclined spout into a vessel below, where the aroma is condensed by cold water in a pan above; the buckets of the wheel being so formed as to contain the requisite quantity of coffee, to insure the turning of the wheel by the weight thereof, and so curved near the periphery as to drag the grains through the trough and up to the spout, and the hopper being provided with a hinged shute, the inclination of which can be increased or decreased to regulate the delivery of the grains of coffee into the wheel, whereby the motion of the wheel is gauged to the temperature of the furnace."

FOR AN IMPROVEMENT IN THE SAFETY FUSE FOR BLASTING ROCKS, &c. *Richard Bacon.*

The patentee says,—"My improvement consists in providing for communicating the fire with more certainty to the charge, to effect which I insert lengthwise through the fuse, and as near the centre of the powder or other combustible matter as may be, a thread saturated with a solution of nitre, sulphur, or any other combustible material or substance. To the above is the claim limited."

IMPROVEMENT IN PNEUMATIC SPRINGS FOR RAILROAD CARS, &c. *John Lewis.*

We make the following extract from the specification:

"The nature of my invention consists in applying the elasticity of atmospheric air, or any permanently elastic gas, by means of an expanding and contracting chamber, or chambers, made in one, two, or more parts, and connected together by means of two or more belts of India-rubber cloth, or other flexible or impermeable material, with alcohol or other liquid interposed, the more effectually to prevent the escape of the air or gas contained in the apparatus, and to aid in relieving the flexible connection, and preventing its rupture by the action of the weight or force on the spring. This mode of connecting two vessels being applicable, without the air, to other purposes, such as hydraulic presses, &c., by forcing water into or between the two vessels. And my improvement also consists in providing this apparatus with one or more of what I denominate a *respiratory chamber*, or chambers, attached to one or both ends of the apparatus, and separated from the main chamber of the apparatus by a diaphragm, or diaphragms, perforated with holes, which will check the passage of the air, and thus relieve the apparatus from the injurious effects of sudden shocks."

Claim.—"What I claim as my invention is, first, the method of connecting the two vessels, composing the pneumatic spring, bumper, rest, &c., by means of two or more belts, with alcohol or other liquid interposed, substantially as described, to be used for the purposes above set forth.

"Second. I claim so arranging the two vessels, and the connecting belt or belts, substantially as described, that the belt or belts shall, at all times, be sustained by either one or both of the vessels, to prevent them from being ruptured by the pressure of the contained fluid, as described.

"Third. I claim dividing the space between two discs into one or more spaces by means of a perforated diaphragm, or diaphragms, to form what I denominate a respiratory chamber, or chambers, substantially as described, and for the purposes explained above.

"Fourth. I also claim making the inner periphery of the outer vessel, or the outer periphery of the inner vessel, or both, beveled or conical, so that the space between the two, in which the flexure of the connecting belt or belts takes place, shall be diminished as the pressure increases, as described, for the purpose of enabling the flexible connection the better to resist the increased pressure, as described; and this I claim, whether used with or without the other improvements."

HARRISON'S RAILWAY CHAIR-PIN PRESSING MACHINE.

[Registered under the Act for the Protection of Articles of Utility. John Harrison, of Lamb Mill, Cowling, Skipton, Proprietor.]

FIG. 1.

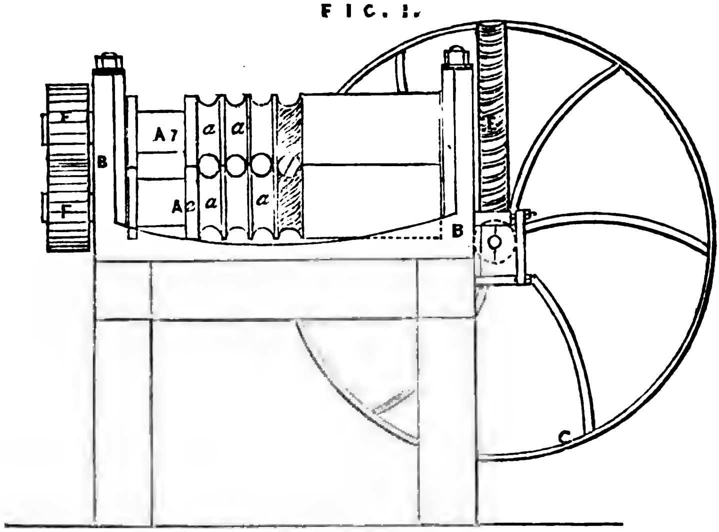


FIG. 2.

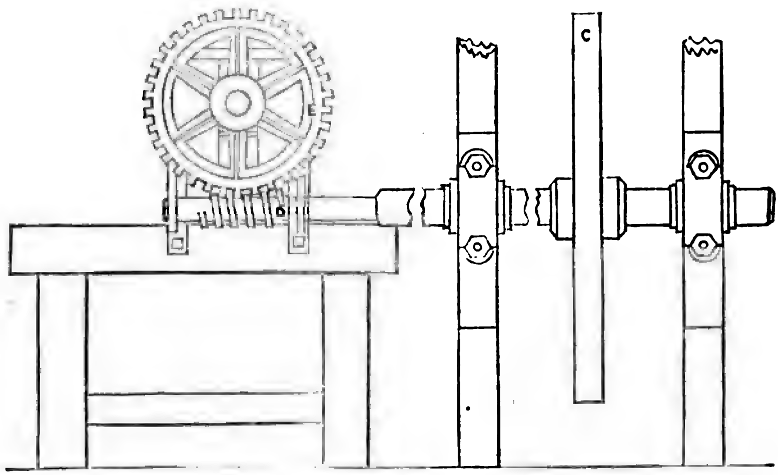


Figure 1 is a front elevation, and fig. 2 a side elevation of this machine. A^1 A^2 are a pair of grooved rollers, which are mounted in suitable bearings in the frame, BB, with the surface of the one roller in contact with the surface of the other roller. The grooves, *a a a*, are of a semicircular shape, so that they form, by their junction, a series of circular openings, through which the pins, after having been previously prepared, are passed. In the partial preparation given

to the pins before having being passed through between the rollers, they are left a little larger than the largest of the openings, *a a a*, so that, after having been successively passed through, from the largest to the smallest, they are fit for use. The surfaces of the three grooves, *a a a*, are plain, and produce plain pins, while the surfaces of the fourth pair of grooves, *b*, are reeded, and produce a reeded pin.

Motion is given to the rollers by a steam engine, or other power, through the intervention of the driving pulley, C; the endless screw, D; and the wheel, E, into which the endless screw gears.

F F are a pair of pinions upon the ends of the roller spindles, to insure the turning of both rollers together.

THE DOVER HARBOUR OF REFUGE — SIR SAMUEL BENTHAM'S MODE OF CONSTRUCTING SEA WALLS.

The Dover Harbour Commissioners, though not giving an unqualified approval to any one of the plans submitted to them, give the preference to that of Mr. Rendel, who, as to materials and mode of construction, recommends the use of masses of hard brick laid in cement.

It does not appear by what means these masses are intended to be deposited in their desired places, and to be connected together so as to form the upright wall which Mr. Rendel proposes. The depth under water in which the wall is proposed to be constructed being 42 feet, were the work to be executed under cover of a dam of the ordinary kind the expense would be enormous.

The least costly mode, it is believed, that has hitherto been devised for constructing sea walls in deep water, was that invented by Brigadier-General Sir Samuel Bentham; and in which manner about 200 feet running of sea wall was executed at Sheerness, some of it at the depth of 27 feet below low-water spring tides, whereby, compared with the ordinary mode, a saving of from 50*l.* to 100*l.* per foot running was made, as the depths under low water varied from 12 to 27 feet. This mode was by means of *hollow buoyant* masses, constructed *on shore* of bricks set in Roman cement, to a height of a few feet above water at low water; then floated to their places, sunk, pressed into the ground, then filled in with concrete composed of the cheapest materials, as chalk, shingle, &c., grouted together with a calcareous cement. The face of the wall to seaward was, above low water, of granite.

This mode of structure might probably be found applicable for the intended sea wall at Dover. It would possess all the advantages of the wooden caissons proposed by Mr. Walker, saving the expense of this costly material, which, besides first cost, from its perishable nature, and the depredations of the sea-worm, could not be considered as forming part of the *permanent* wall.

As to materials, Sir Samuel's investigations had produced conviction that Kentish ragstone was, when of a good variety, particularly durable; and he ascertained that it could be furnished of the best quality at a much lower price per foot cube delivered at Sheerness, than an equal bulk of brick. Had the works there been continued according to his proposals, that stone would have been generally employed instead of brick. The additional cost of freight to Dover, might render it there more costly than brick.

The cement used for the masses at Sheerness, proved, when set, harder than the bricks themselves—the latter always giving way on trial rather than the cement; and this whether the experiments were made by pressure or by percussion.

The cement was burnt on the spot, and used fresh; but unusual precaution was taken in the choice of the cement stone. There having been at that time no chemist in the naval department, Sir Samuel obtained for his assistant the "Mechanist," a small chemical apparatus with the necessary tests, who on experimenting on different cement stones, ascertained that the difference in quality of the cement produced from them depended on the different chemical properties of the stones themselves. This circumstance seems to merit more attention than is usually given to it in the manufacture of Roman cement.

The mode which Sir Samuel devised for ascertaining the nature of the soil and substrata under water at Sheerness, is applicable to a great variety of works, and perhaps might be employed with advantage at Dover; for although by the diving-bell, boring, &c., in the usual way, much useful information may be obtained, yet a more perfect knowledge of the substrata, and of their power of

bearing great weights, would be afforded by examination of them in the dry, as if under cover of a dam.

He devised an iron cylinder of sufficient diameter to admit a man, and to allow him to work within it; this cylinder entering the ground below water, and extending upwards to above high water. It had a valve inside, so that, when closed, water might on occasion be let into the upper part of the cylinder without entering the lower part of it. The following letter from Mr. Kingston, master millwright in Sir Samuel's manufacturing establishments in Portsmouth Dockyard, will afford a description of the use made of that cylinder:

"Portsmouth Yard,
"July 10, 1812.

"Honourable Sir,—I received a letter from Mr. Goodrich this morning, in which he informed me that you wished me to send an account of the trial of the ground at Sheerness by means of the iron cylinder; therefore, honourable Sir, I here give you as correct an account as I possibly can, viz.:—Forty-two feet in length of iron cylinder, weight about seven tons, was placed in a line with the front of the present new wharf. The ground (within the cylinder) for several days after the cylinder was placed, was not water-tight; but as soon as the water was admitted upon the valve which was in the inside of the cylinder,—which valve was placed at a distance of eighteen feet from the bottom, for the purpose of pressing the cylinder into the ground, by admitting a column of water upon the said valve equal to three tons and a half,—the ground then was completely water-tight, and the distance the cylinder was in the ground was about two feet eight inches. The cylinder remained in that state until such time as you came to Sheerness, when you ordered me to get some assistance, and bore into the ground in the inside of the cylinder; and in boring about eight feet down, the ground appeared to consist of chalk, sand, and clay united together, and in boring to this depth, no water came into the cylinder; but in boring a few inches further, the auger went instantly down about ten feet; the water then came into the cylinder, and soon was at the same height in the inside of the cylinder as it was on the outside. The auger was left in the ground that night, and in the morning the ground had so completely fixed the auger, that I was obliged to take off twelve feet of the cylinder, and get a launch and make fast to the auger at low water, for the purpose of drawing the auger.

"The height of the water on the outside of the cylinder was forty-two feet at high-water.

"I remain, honourable Sir,
"Your most obedient humble servant,
"WM. KINGSTON.

"Sir, Samuel Bentham,
"Navy Office, London."

The iron cylinder, although composed of several separate rings capable of being connected water-tight together, one above the other, having of course been weighty and cumbersome to remove, led Sir Samuel to the invention of a wooden one, shod with iron, which he caused to be employed in Portsmouth Harbour. In a letter from Mr. Kingston, dated Portsmouth Dockyard, 28th July, 1812, he says, respecting the wooden one, "The ground on which the cylinder was first placed is water-tight, and I can transport the cylinder with great ease to any part of the harbour you may think proper to point out, as the cylinder will, without any assistance, float in 12 feet water."

It was by making himself perfectly acquainted with the nature of the ground on which his great works at Portsmouth were to be erected, that structures there, according to his designs, were invariably exempt from failure, though all of them had been pronounced to be "hazardous, dangerous, and unsafe." It was the knowledge which he obtained by means of the cylinders, of the water-tight crust at Sheerness, and of the weights it would bear at different parts without danger of penetrating to the running sand and water underneath it, that gave him confidence in the mode of construction he determined on; and there exists undoubted evidence of the stability of his masses, though they were no longer employed after the abolition of his office.

The success of the wooden cylinder led Sir Samuel to the invention of moveable wooden dams, as described in his patent of March 5, 1812, and which should dams be found necessary at Dover, might, if adopted, be a means of saving much expense. He had intended employing them in the construction of a mastery at Portsmouth. After the abolition of his office, he furnished the Navy Board with short notes respecting various matters that had been referred to him; in relation to that mastery, after other observations, he added the following extract of a minute to that Board:

"I have also to observe that the experi-

ments made with the cylinder, for the making of which I obtained the Board's authority of 4th Feb., 1812, seems sufficient to show that a new mode of excluding water by moveable dams, invented by me, particularly with a view to this and other works for the port of Portsmouth, is well suited for carrying on works under the circumstances of the soil of this spot, so that the under-water works proposed, might be executed at a far less expense than under cover of an ordinary dam.

"SAMUEL BENTHAM."

"Feb. 4, 1813."

MR. W. B. JOHNSON'S ROLLER ECCENTRIC —IMPROVEMENT SUGGESTED.

Sir,—In your number for April 22, a Mr. Johnson is stated to have taken out a patent for some improvements in the steam engine, among which is an eccentric, to work with rollers in the band. Some time back, I altered a dressing machine, and used an eccentric instead of the usual crank. My improvements, I thought, were calculated to render it easier to work; but I did not find it so far answer my expectations. A friend suggested that this arose from there being so much more friction on an eccentric than on a crank; and so I set to work to reduce it. The result was, the placing of three rollers *in the centre*, instead of in the band, which, I think, is preferable, as they are more out of the way, and can be larger. I made the models for casting, but cannot say if the plan will answer, as I have not tried it in work. Should it be of any use to Mr. Johnson, or any other person, I shall be happy to show it to them.

I am, Sir, yours, &c.,

W. J. JOYNER.

Aveley, near Romford,
June 29, 1848.

LOW'S PATENT IMPROVEMENTS IN THE MANUFACTURE OF COPPER.

[Patent dated November 4, 1847; Disclaimer (of the words "zinc, tin, and other metals") enrolled May 3, 1848. Specification enrolled May 4, 1848.]

Take 42 parts of the black oxide of manganese, 8 parts of plumbago, 2 parts of nitrate of potash (or nitrate of soda or lime,) and 14 parts of anthracite coal, or wood charcoal; mix these together, and add to the copper ore when melted 25 lbs. of the mixture for every ton of ore. Then withdraw the slag resulting from this first operation, and introduce another 25 lbs. of the mixture. Skim off the slag once more, and throw in a further quantity of the mixture; in short, treat the melted ore in this way until the metal appears to be "in a sufficiently forward state" to be run off.

Claim.—To the combined use of manganese, plumbago, nitrate of potash, soda, or lime, and carbon in the manufacture of copper.

ARTHUR'S DECIMAL MONEY, WEIGHTS, AND MEASURES.

[From a small Pamphlet, entitled, "Proposed New Patent Decimal Coins, Weights, and Measures," by "Arthur;" printed at Swansea.]

It would be a great advantage to all kingdoms—it would be a great advantage to travellers—it would greatly facilitate and increase commerce, if there were the same money-coins, weights, and measures, in all the principal countries in Europe and America.

The English statute, 5 Geo. IV., removed a great many of the imperfections from the English weights and measures, but as there are still latent imperfections in them, it is neither advisable nor desirable that they should be adopted by foreign nations.

The following tables of money, weights, and measures will be found, on rigid examination, more convenient and perfect than any extant in any part of the world. The names of them are also more simple and easy to learn than any others.

MONEY.

100 Mites or Centimes make 1 Florin.
10 Florins .... 1 Pound sterling.

LONG MEASURE.

10 Metres or Mites make	1 Link or Span.	
10 Links	1 Ile.	I
10 Iles	1 Xile (pron. Zile,)	X
10 Xiles	1 Centile.	C
10 Centiles, or 1000 Iles	1 Mile, (Railroad.)	M

SQUARE MEASURE.

100 Square Metres make 1 Square Link
100 Square Links .... 1 Square Ile.
100 Square Iles .... 1 Square Xile.
10 Square Xiles .... 1 Acre.
1000 Square Acres .... 1 Square Mile.

CUBIC MEASURE.

1000 Cubic Metres make 1 Cubic Link.
1000 Cubic Links .... 1 Cubic Ile.

AVOIRDUPOIS WEIGHT.

10 Mites make 1 Dixweight.
10 Dixweights 1 Ib., 1 lb., or Imperial Pound.
10 Ibs.............. 1 Xib.
10 Xibs .... 1 Centib.
10 Centibs...... 1 Mib or Milb.

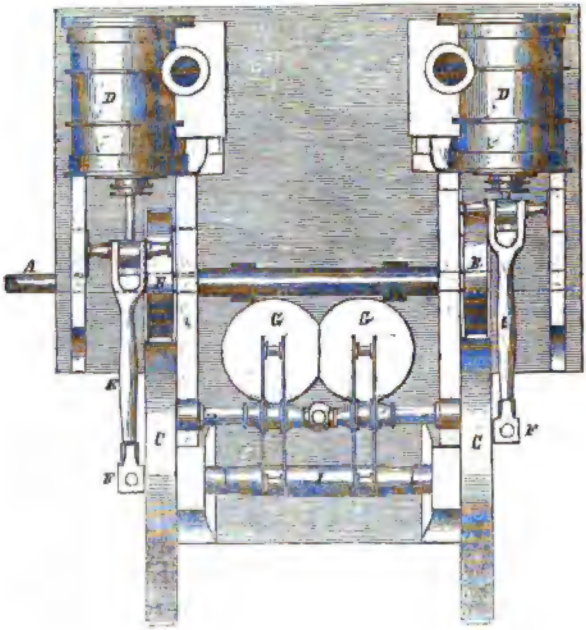
LIQUID MEASURE.

10 Mites make 1 Verre or Glass.
10 Verres ...... 1 Kan.
10 Kans......... 1 Ig or New Imperial Gallon.
10 Igs............ 1 Xig, (pronounced Zig.)
10 Xigs .... 1 Centig.

These coins, weights, and measures, are not only simple and convenient, but they are based on such sound and scientific principles, that I am confident they will deserve, and I trust will obtain, the approbation of all scientific persons and the Governments of all countries.

MR. E. HUMPHRY'S IMPROVEMENTS IN STEAM ENGINES, AND IN ENGINES OR APPARATUS FOR RAISING, EXHAUSTING, AND FORCING FLUIDS.

[Patent dated January 4, 1848. Specification enrolled July 4, 1848.]



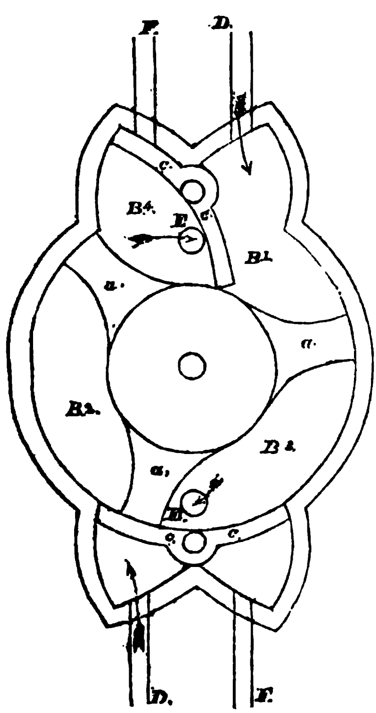
The sort of steam engine to which Mr. Humphry's improvements have more particular relation, is that now usually employed in screw propelling, which is of the class called direct-acting, but works, at the same time, through the medium of multiplying wheels; and though these improvements consist but of matters of arrangement, they will be found of very great value and importance. By a better disposition of the ordinary parts of the engine, he is enabled to dispense entirely with one prominent member (the crank,) and to bring the whole within a much smaller compass than has ever before been done. A pair of engines on this plan have been already fitted to the Government screw steamer *Reynard*, with which some most successful trials were made down the river last week; and there seems little doubt of the same plan being henceforth generally adopted.

The prefixed figure represents a top plan of a pair of screw-propelling engines on this plan. A is the screw-shaft; B B, pinions attached to the screw-shaft; C C, driving-wheels, which gear into the pinions, B B; D D, the cylinders, the pistons of which are connected by rods, E E, to pins, F F, on the outside of the driving-wheels; and G G, the air-pumps, which are worked by cranks or eccentrics on the shaft, I. In this improved arrangement, the driving-wheels occupy the positions usually assigned to the engine-cranks; that is to say, each wheel revolves in a space between a straight line drawn through the centre of the piston-rod of the adjoining cylinder and a parallel line drawn through the adjoining bearing of the main shaft; and the so placing of the driving-wheels enables the pistons to be connected directly to them, instead of through the intervention of cranks, as usual.

Mr. Humphry's patent includes also an improved description of valve for engines and apparatus used in raising, exhausting, and forcing fluids, such as steam engine air-pumps, atmospheric railway pumps, &c. A metal plate (of a square, or any other suitable form) has

apertures made in it for the inflow or outlet of the fluid. Each aperture is covered by a piece of steel, or other like flexible metal, of about a sixteenth of an inch in thickness, which is made fast at one end by screws, while the other end is left free, so that while it yields with the greatest readiness to the pressure of the fluid, it closes instantly again on the cessation of the pressure, without noise or any liability to derangement.

DESIGN FOR A ROTARY STEAM ENGINE.



Sir, — If you consider the above sketch of a rotary steam engine, with explanation, worthy of the space occupied, I shall feel obliged by their insertion in your Journal. I have endeavoured to show that the engine there exhibited will not consume more steam than a vibrating engine of the same proportions; if I am wrong in my calculations, I shall be happy to be put right by any of your readers who may be inclined to take the trouble.

I calculate the consumption of steam in comparison with a vibrating engine in the following manner:—Supposing the diameter of the rotary engine to be 1 foot 6 inches, the circumference of the outer circle described by the pistons 4 feet 6 inches, the area of the cylinder being 4½ inches, the circumference of the inner circle will be 2 feet 3 inches; and, consequently, the intermediate, or real length of the cylinder will be 3 feet 4½ inches, from which deduct 6¾ inch, or one-sixth the space occupied by the pistons, it leaves 2 feet 9¾ inches, the actual length of the cylinder occupied by steam. The arm being equal to 6¾ inches, would require a cylinder in a vibrating engine of 15½ inches, independent of the space occupied by the piston, which being twice filled for one revolution would be 2 feet 7 inches of steam consumed; the area of the cylinder in each engine being the same, consequently, in the rotary engine 33¾ inches of steam is consumed in one revolution, and in one revolution of the vibrating engine 31 inches, being a difference of $\frac{1}{13}$th greater consumption by the rotary engine; but as during $\frac{1}{10}$th of the revolution of the rotary engine *two pistons are in full force*, I imagine the difference would be small, and what there was in favour of the rotary engine, taking into account the increase of power from the operation of *two pistons* during $\frac{1}{10}$th of the revolution, and the advantage to be obtained by a direct rotary motion.

I am, Sir, yours, &c.

STEPHEN SHARP.

8, Mount-row, New Kent-road.

Description of the prefixed figure.

a, a, a, three pistons or arms revolving in a circular box or cylinder, B_1, B_2, B_3, B_4; *c, c, c, c,* two valves moving on a centre with the action of the pistons and the steam admitted at the back of them by the feeding-pipes D D, the exhaustion pipes being at E E; the two cells, B_1 B_2, are at present occupied by steam, which exhaustion is effected in cells B_3, B_4. F F are feeding pipes in the reversed action.

It is possible that a few of our readers are aware that some "out-of-the-world" place, bearing the name of Gresham College, once existed; and, from the name of Sir Thomas Gresham being so intimately connected with the history of the Royal Exchange, they might be led to suppose that the "merchant prince" was somehow or other associated with the history of that extinct and almost forgotten college. They would conjecture rightly; but it is only in an encyclopædia, or a history of the Royal Exchange, or in the "Life of Gresham," that the great majority of our readers will learn whether it exists in Oxford, Cambridge, London, or Timbuctoo.

Sir Thomas Gresham did found a college in London; endowed it with seven professorships of the "liberal sciences" (as they were then called;) and gave the professors apartments for collegiate purposes in the Royal Exchange, with fifty pounds per annum for each of them—a large sum in the days of Elizabeth. It was, indeed, in this very college, that the Royal Society had its London origin; and in this very college the builder of St. Paul's was once the professor of geometry? Where is it now! Where has it been since the time when the Royal Society transferred itself as an independent body to Crane-court? Who are its professors? Where do they lecture? What public benefit results from this endowment, to the "liberal sciences" of our own day? We must go further than books will tell us to answer these questions.

The fact is, that the college has ceased to exist, in more than a city-name, for a century and a half. For a considerable time no lectures were given, and even whilst they were given, it was "in a room over the Royal Exchange," as the traditionary stories of the encyclopædias tell us, which was never intended to be discovered, through the tortuous windings that led to it, by any mortal, either citizen or scholar. Professors, indeed, were appointed, and their salaries were regularly paid; but it yet is to be learnt that one single professor of that college has made the most trivial addition to the science upon which he was paid for lecturing, either by his personal discoveries or the diffusion of learning, for more than a century. The college and its funds have been, in plain truth, subjects of as completely corrupt abuse as any one amongst the whole range of city trusts; and in saying so much, we do not anticipate the slightest attempt at the temerity of contradiction. Who, indeed, are the professors, and what is the qualification for their appointments? We may see, indeed, now and then an advertisement in the *Times*, giving their names, the subjects on which they will lecture, and the days on which the successive acts of the dull farce "will come off." But what cultivator of the "liberal sciences" knows any one of them, even by name, as possessing a common-place reputation for an ordinary amount of information about his particular subject—to say nothing of zeal and ability for its extension? To use the language of the time (and of the *Times*, too, when it suits that remarkable paper to speak out) these professorships have been, from the beginning of the last century, a series of JOBS, as gross as any upon record. They are given without the least reference to merit or qualification, merely because some influential member of the Gresham Trust wishes to make a little addition to the income of his physician, his parish curate, of some family connection of his own, or the *protegé* of some personal friend. The testator's *intentions* are set aside to serve class interests and selfish relationship. The aristocratic jobbing with public appointments has at length received some share of public attention and condemnation: it is time that the city-jobber, whether as an individual member of society, or as the trustee of a public benefaction, should be subject to the like scrutiny and the like disgrace.

The Corporation and the Mercers' Company have (since the exertions of a worthy and independent citizen have compelled them to do *something*) built a new house in Gresham-street (*vulgo*, Coleman-street,) and they have the lectures delivered in duplicate, both as to language and as to time. They have compensated their lecturers for their trouble by also doubling the nominal salary devised by the founder. These "wise men of Gotham" measure science by *quantity* only: whether its quality be good, or even genuine, concerns *them* not. Ignorant of science as the poor

savage is of the precious stones, a coloured bead of common glass pleases them just as well as the diamond of the Autocrat or the Great Mogul. It does not even concern one in a hundred of them; for science is not their toy, nor Gresham science even the toy of their wives and daughters. If their ladies should, in the course of their fashionable vagaries, think a taste for learning would look gracefully upon their sweet faces, they will not go so near the vulgar shop in the city as to seek it at the Gresham, but will "patronise" the Royal Institution or the Polytechnic, where science will, at least, have the merit of being fashionable.

The Gresham professors are appointed *for life*, whilst their emolument in no degree depends upon the efficiency with which they perform their duties. It is always an *appendage*, the duties of which are to be shuffled over with the least possible trouble; and is never looked upon as an appointment calculated to do honour to the man, or demanding even the show of a reputable attempt to execute its duties honourably or usefully. As the Charterhouse was once used by those who held the power of nomination to its benefits, as a convenient mode of pensioning off their butlers and footmen—so the Gresham professorships are made available for answering the claims which needy or greedy relatives may otherwise make on the purse of the wealthy citizen.

Ought these things to be? Are the intentions of Sir Thomas Gresham to be set aside, and the funds which he devised to be *perverted* from the *spirit* of the donor; the trustees simply taking care to keep to the windward side of the mere letter of the founder's will—and not always even that? This must cease. If, indeed, the trustees be not absolutely besotted with their hereditary indulgence in this kind of riot, they will themselves adopt a different course as each professorship becomes vacant. We have, however, but little hope; for there is no system so pertinaciously adhered to by corporate bodies, as the chartered practice of corruptly exercising their patronage. If, however, they will not remove the "unclean thing" from amongst themselves, the sanatory commissioners under the bill for intellectual health will do it for them—and that with a rough hand.

The geometry-professor's name appeared in the newspaper obituaries a few days ago. The Rev. Dr. Birch was of a city and corporation family, as we understand. He took his degree in 1802, at Cambridge; was of St. John's College, and came out on the Tripos *only tenth senior-optime, even at* THAT DAY; was appointed Gresham professor in 1808, and has therefore held that office for forty years, besides considerable church preferment, amongst which was a prebendal stall in St. Paul's. For his so-called lectures on geometry alone he received no less a sum than *four thousand pounds!*

We have no inclination to detract from the personal worth of the deceased professor; for besides having no grounds by which to judge of him under this aspect, it would under any circumstances be altogether irrelevant. He was, we doubt not, as active a clergyman as many of his brethren; and quite as active, as a soporific audience is calculated to render, either a lecturer in the pulpit or a professor in his "chair." Under the latter aspect we here alone view him, and only seek to understand his character as the illustration of the system of appointing men to trusts, for which neither their actual information nor their intellectual constitution, adequately prepare them. Dr. Birch, as it appears to us, possessed no one qualification, beyond that of interest to get the appointment, for the office which he held so long, and for "performing the duties" of which (as it is facetiously called,) he received so large a sum of money. We will willingly retract what we say, if any five persons will come forward and pledge their honour, that the lectures of Dr. Birch have either created in them a sufficient love for geometry to induce their own effective cultivation of it; or that they have gained from those forty years' lectures any single idea which was not as common as flints in a chalk-bed! Nay, we will reduce the five witnesses to a single one—only subject to this condition, that he has given public evidence of his knowledge of the difference between Taylor's theorem and Christie's theorem.

But what are the *published* evidences of the acquaintance of Dr. Birch, or any one of his *patronised* colleagues, that they even understand, to a moderately fair degree, the several "liberal sci-

ences" upon which, term after term, they repeat their insignificant lectures? As to *discoveries* in those sciences—tell us where to look for them. ECHO answers, "Where?" but all the world is dumb.

Who is the next to act this farce, and receive the pay? No doubt he is cut and dried—ready to enter on his duties in such fashion as he may be able, and to draw upon the Gresham exchequer his pay as regularly as the "public creditor" his dividends at the Bank. We do not read the signs of the times aright, if he be not the *last* of his race. This will not—cannot—must not—go on. *Public trusts must revert to their intended uses.*

Had the whole of the appointments, referred to forty years back, and had men, either qualified by their acquirements, or honoured for their professional energy and scientific discoveries, been subsequently chosen, then, indeed, our condemnation of the system would have been gladly exchanged for the open-hearted approbation which such a choice would deserve. Appointments, however, have since been made—and made on the old principle of "providing for friends and dependents,"—the exercise of undisguised corporation influence. Even were it otherwise, the opinion entertained by scientific men as to the mode of appointment is so generally in accordance with what we have stated, that no one who has attained to the slightest station in his profession, would think for a moment of offering himself. It is, indeed, just possible that some chivalrous spirit, ardent to render such a post *a post of real usefulness*, might risk an application; but we all know that where the *form of an election* may be imposed upon the public, it is nothing more than a blind to persuade the lieges that all is conducted fairly. No matter for the trouble and anxiety created for the candidates who are predestined to be set aside, in acquiring testimonials, and producing proofs of their competency! This is such an every-day affair even in the management of "getting up" a commercial joint-stock company, that no one is surprised at the result. See even, too, the conduct of the new Oxford Board of Trustees of the Taylor Institute, where the same outrage has been perpetrated; where men eminently qualified for the Philological chair have been set aside, in favour of a man who has not the most ordinary qualifications for its duties—simply because that man is the fallen minister of a fallen dynasty! Such trifling with the scientific public as that of the Gresham Committee, and with the literary, as that of the Taylor Board, deserves, and will receive, the indignant denunciation of every man of high and honourable feeling.

If the present Trustees of the Gresham do not wish to be held up to perpetual disgrace for abuse of their trust, let them at once change the old venal system of appointment, into one which is both in accordance with the spirit of the times—with the ordinary principles of Christian honesty—and with the unmistakable intentions of the founder himself. Let them consider themselves as trustees for the public, not their office as a fief of their own, to be exercised according to their own interests, and the interests of family and party. Let them rest assured, at any rate, that if the purposes of Sir Thomas Gresham be thus perverted, they will pay the penalty of public odium. Whatever of proved abuse shall occur in these days, will go down to posterity with its author's name attached; and we do not think the Trustees have such an extraordinary fund of character, as to be well able to afford the loss of so much of that commodity as this will entail.

We had intended to point out the principles upon which such an election should be conducted as well as the changes which would secure the fulfilment of the founder's intentions. We can, however, only indicate them briefly this week: but we shall probably return to the subject in our next Number.'

1. Instead of a life appointment to the professorship let it be limited to three, or at most to five years: the same person not occupying the chair during two consecutive periods. This would prevent the lecturers sinking down into the contemptible routine of repetition to which they have now sunk.

2. Let the appointment be considered *honorary* rather than one of mere emolument. The stipend is too contemptible to attract the attention of able men, on the ground of pecuniary reward: but were the appointment exercised as a reward and recognition of eminent services in the cause of sciences and literature, the leading intellect of the coun-

try would be ready to accept it, despite its limited reward in money. Whether the Gresham Trustees understand it or not, there are higher prizes in the estimation of the intellectual classes than Gresham gold. Developed intellect is not a "money-grub."

3. Let no man be chosen who has not rendered *valuable services* to science or to scientific education; and who is not, moreover, earnestly devoted to such labours as will effectually carry out the fundamental objects of Sir Thomas Gresham. Hundreds such exist in this country, so that there is a wide range of choice. We make no objection to a Cambridge man in reference to the Chair now vacant: but, on the contrary, should be glad to see any one of many whom we could name so appointed. Of non-academic men, too, we could specify several eminently fitted for the office: but to comply with the general predilection in favour of Cambridge mathematicians, we would at once concede the claims of all others: only subject to this proviso; that the Cambridge geometer should be generally admitted to stand at the head of his class, whether as respects acquirements, earnestness, capacity for teaching, or successful labours in diffusing knowledge and creating an interest in it. To such men, for instance, as Mr. Potts, we should cordially award such an honour.* There can, at least, be no questioning the powers of a man whose name is before the world.

4. Let it be incumbent on each professor to publish at the expiration of his term of office, the lectures which he has given—or at least such parts of them as may be conducive to the extension of education, to clearing up difficulties in the science upon which he lectured, and to the actual extension of the science itself. The value of this method is evinced by the effect of publishing the Bampton Lectures, the Harveian and Hunterian Orations, and some others that may be quoted. We would gladly see the Gresham Lectures in the same category.

* Mr. Pott's Euclid has been more than once referred to in our Magazine, although we know nothing of him personally. We have mentioned him now incidentally as the principal Cambridge geometer (in strictness of meaning) that occurs to our thoughts. Our readers will see our own estimate of his works at vol. xliv. p. 137, vol. xlvi. p. 155, and vol. xlvii. p. 568.

ELECTRO PAINTING.

(From the *Athenæum*.)

I beg to submit to your notice a new method of engraving, which I trust will prove a desirable addition to the styles at present in use. It is unnecessary to trouble you with a detail of the steps which led me to adopt this process,—the object of which is to engrave in copper the very touches of an artist's brush, so as to produce a *fac-simile* of the drawing. The process is extremely simple, the cost of the materials trifling, and the only skill required is that necessary for painting in oil or water colour. The artist has the power of making alterations in his design if necessary; the finest touches may be given, the finest lines can be executed, and any depth of tint produced; and the drawing has the great advantage of not being reversed in the print.

The principle of this process consists in the production of an electrotype copper cast of the drawing itself. The drawing is to be made on a perfectly smooth, unburnished metal plate, the size of the drawing:—German silver is well adapted to the purpose. This plate is not injured by the process, and can be used repeatedly. The pigment employed is thus formed. Two parts of tallow and one of wax are to be well mixed together in a melted state, and blackened with the finest lamp-black: a small portion of this mass must then be rubbed down with turpentine, by the aid of a palette-knife, to the consistency of oil-paint. With this paint, a drawing is to be made with an ordinary paint brush on the German silver plate. The paint flows readily from the brush, and forms raised touches on the smooth plate; the touches intended to print the darkest being raised the highest. Various methods of working will suggest themselves to artists. A leather pad is very useful for producing broad flat tints; and good effects may also be obtained by using a leather stump. Even the palette-knife may occasionally lend its aid. The artist can judge of the effect of the print from the colour of the drawing; the tints of the one corresponding very closely with the tints of the other. The highest lights are obtained either by leaving the German silver plate bare, or by wiping out portions of the paint. When the drawing is finished, the finest French bronze powder (the same as that used for printing gold letters, must be freely dusted over its surface with a large and soft camel's hair brush, care being afterwards taken to brush away all the bronze which does not adhere to the drawing. A drawing with a metallic surface is thus obtained; on which an electrotype copper plate, a perfect cast of the original drawing, and of sufficient thickness to bear

the pressure of printing, may be readily deposited.

I propose the term "Electro Painting" as appropriate to this style of engraving. The electrotype plate when taken off the drawing must be carefully washed with turpentine, to remove any bronze or paint which may adhere to it, the edges must be cut square, and the back of the plate filed smooth; and it is then ready for the printer. The prints thus produced have all the richness and depth of etching, and at the same time show distinctly the touch of the artist's brush. The specimens I send for your inspection must be regarded as the work of a mere amateur; but I trust you will find in them sufficient evidence of a power which in more skilful hands is capable of producing valuable results.

I am, Sir, yours, &c.,
FERGUSON BRANSON,
M.D., Cantab.

Sheffield.

THE VENETIAN GLASS WEIGHTS.

An exceedingly beautiful description of weights for library tables, to which the above name has been given, has recently made its appearance in the fancy stationary shops. The weight—which is of various forms, circular, oval, square, &c.—consists of a mass of clear, white crystal, inside of which, and embodied in it, there are representations, in coloured glass, of coral, flowers, and other objects, formed by laying together the fibres of glass of various colours, so assorted that a section across the fibres exhibits the objects intended to be represented. The thing, however, is not altogether new, as will be seen from the following description of two specimens, given by Winkelmann, in his "Annotations on the History of the Arts among the Ancients:"

"Each of them is not quite one inch long and one third of an inch broad. One plate exhibits, on a dark ground of variegated colours, a bird, representing a duck of various very lively colours, more suitable to the Chinese arbitrary taste, than adapted to show the true tints of nature. The outlines are well decided and sharp; the colours beautiful and pure, and have a very striking and brilliant effect, because the artist, according to the nature of the parts, has in some employed an opaque, and in others a transparent glass. The most delicate pencil of the minature painter could not have traced more accurately and distinctly either the circle of the pupil of the eye, or the apparently scaly feathers on the breast an wings, behind the beginning of which this piece had been broken. But the admiration of the beholder is at the highest pitch when, by turning the glass, he sees the same bird on the reverse, without perceiving any difference in the smaller points; whence we could not but conclude that this picture is continued through the whole thickness of the specimen, and that if the glass were cut transversely, the same picture of the duck would be found repeated in the several slabs; a conclusion which was still further confirmed by the transparent places of some beautiful colours upon the eye and breast that were observed. The painting has on both sides a granular appearance, and seems to have been formed in the manner of mosaic works, of single pieces, but so accurately united, that a powerful magnifying glass was unable to discover any junctures. This circumstance and the continuation of the picture throughout the whole substance, renders it extremely difficult to form any direct notion of the process or manner of forming such a work; and the conception of it might have long continued enigmatical, were it not that, in the section of the fracture mentioned, lines are observable, of the same colours which appear on the upper surface, that pervade the whole mass from one side to the other; whence it became a rational conclusion, that this kind of painting must have been executed by joining variously coloured filaments of glass, and subsequently fusing them into one coherent body. The other specimen is of almost the same size, and made in the same manner. It exhibits ornamental drawing of white, green, and yellow colours, which are traced on a blue ground, and represent volutes, beads, and flowers, resting on pyramidally converging lines. All these are are very distinct and separate, but so extremely small, that even a keen eye finds it difficult to perceive the subtle endings; those, in particular, in which the volutes terminate; notwithstanding which, these ornaments pass uninterruptedly through the whole thickness of the piece."

CRANE AND JULLIONS' PATENT IMPROVEMENTS IN THE MANUFACTURE OF "CERTAIN ACIDS AND SALTS."

[Patent dated January 18, 1848. Specification enrolled May 18, 1848.]

The "certain acids" referred to in the title of the patent are the nitric and oxalic acids, and the improvements in their manufacture may be described generally as consisting in a mode of adding the materials to be decomposed by degrees, as required, to the mother liquor, which enables the

operator to employ the liquors or materials at a high temperature; also in converting the oxides of nitrogen into nitric acid by the decomposition of water by means of chlorine.

The improvements in the manufacture of salts consists in oxidizing metallic substances and manufacturing nitrates at the same time, by bringing oxides of nitrogen and oxygen gas, or atmospheric air, into contact with a metal or metallic oxide, or any alkali or alkaline earth; also in obtaining tartrates of the alkaline earths, by decomposing the tartrates of potash by means of the sulphurets of the metallic base of those earths; and likewise in passing any of the oxygen compounds of nitrogen, together with any compound of hydrogen and carbon, or any mixture of hydrogen with a compound of carbon, or even free hydrogen, through a tube containing any catalytic or contact substance, such as platinum or asbestos.

MR. C. P. MANSFIELD'S PATENT IMPROVEMENTS IN THE MANUFACTURE AND PURIFICATION OF SPIRITUOUS SUBSTANCES AND OILS APPLICABLE TO THE PURPOSES OF ARTIFICIAL LIGHT AND VARIOUS USEFUL ARTS, AND IN THE APPLICATION THEREOF TO SUCH PURPOSES, AND IN THE CONSTRUCTION OF LAMPS AND BURNERS APPLICABLE TO THE COMBUSTION OF SUCH SUBSTANCES.

[Patent dated November 11, 1847. Specification enrolled May 11, 1848.]

The specification of this patent is of extraordinary length; if given at length, it would fill a couple of our numbers, at least. For the following abstract of its multifarious contents, we are indebted to the learned patentee himself:

The invention is divided into five parts, which are, respectively—

1st. An improvement in the manufacture of spirituous substances and oils.

2nd. An improvement in the purification of spirituous substances and oils.

3rd. An improvement in the application of spirituous substances and oils to the purposes of artificial light.

4th. An improvement in the construction of lamps.

5th. An improvement in the construction of burners.

The First Part

Is a method of separating from tars, bituminous matters, and empyreumatic oils by distillation, hydrocarbons or spirituous substances so volatile that they will yield sufficient vapour to a current of non-luminiferous gas or common air passed through them, to enable such gas or air to burn with a luminous flame; and further, an application to coal-tar, or to the substances distilled from coal-tar, of a knowledge of the different volatility of certain substances not hitherto separated from each other, which exist in the tar, so as to obtain certain distinct products; and in the further manufacture from certain of these products of a fragrant oil or oils.

The products thus manufactured are six; and for distinction are thus named—*alliole*, *benzole*, *toluole*, *camphole*, *mortuole*, and *nitro-benzole*.

Alliole is an extremely volatile fluid hydrocarbon, which is manufactured from coal-tar, or coal-naphtha, by rectifying them in an apparatus similar to those used for the rectification of alcoholic spirits. It is applicable to all the purposes for which benzole may be used, but is more volatile.

Benzole is a hydrocarbon which boils at 176° Fah., being of the same volatility as spirit of wine. It is manufactured in the same manner as the alliole, by distilling a little further. For many purposes it is useful to receive these two fluids together. They are both excellent solvents of gutta percha, of India-rubber, of wax, of grease and oils of all sorts, of mastic and many other resins, of copal and Animé, by exposing them to the vapour of the fluids, so that it shall condense upon the gums; of shell lac, by mixture with alcoholic or pyroxylic spirits; of camphor, sulphur, phosphorus, and many other substances. The solutions of gutta percha or caoutchouc, or these mixed, when spread on a smooth surface, leaves on drying, which it does rapidly, a varnish, which may be peeled off in the form of a thin membrane; or, spread on the skin, forms an excellent plaster. They may be used as substitutes for ether in various pharmaceutical processes, and for many of the purposes to which alcohol is applied. Benzole, if inhaled, acts in the same way as chloroform, and either in procuring insensibility to pain. It is applicable to the manufacture of perfume, as described under "nitro-benzole." Benzole and alliole form the part of coal-tar, which is separated from it by treating in the manner proposed for bituminous matters in general; and, equally with such spirituous substances prepared from these other tars is applicable to the production of vapourized air, in the manner described in the third part of the invention. It is also particularly applicable to the manufacture of fuel for vapour lamps, as described also in the third part.

Toluole is less volatile than benzole, and has nearly all the same properties as common

rectified coal-naphtha; it consists of so much of the light coal-naptha as remains after the separation of the benzole by rectification, and of the camphole, as described next. It is less volatile than benzole, and more volatile than oil of turpentine; and is applicable to all the purposes of the best coal-naphtha, when purified, as described in the second part of the invention.

Camphole is obtained by distilling off the toluole from the naphtha, and then rectifying the residue. The time when the receiver is to be changed is known by applying a lighted match to the surface of samples taken from the still-worm; when such samples no longer take fire on the surface, the camphole is collected, till the temperature in the retort has risen so high that solder melts on it, or till oil heavier than water distils over. This, when rectified, forms a substitute for camphine, and is useful as a solvent, when a very volatile fluid is not required. It is of nearly the same qualities as oil of turpentine.

Mortuole is prepared by rectifying the heavy or "dead oil" of tar, reserving what comes over between the temperatures about 330° Fah. and 500° Fah. When purified according to the method of part second, it forms a substitute for fixed oils in many purposes to which they are applied; and, by mixture with spirit, as described in part three, forms an excellent lamp oil. It is also useful in making varnishes.

Nitro-benzole is a fragrant heavy oil, made by dissolving the light oils of coal-tar, for which rectified benzole is preferred, in strong nitric acid, and then diluting the acid with water, which separates the oil formed by the process. This oil is useful as a substitute for oil of bitter almonds in perfuming soap, or in flavouring confectionary, and has no poisonous properties.

The Second Part

Is a method of purifying and deodorizing bituminous and empyreumatic oils, which is partly applicable to such substances in general, and partly to some of the special substances manufactured according to the first part of the invention.

The agents used in deodorizing the empyreumatic oils are nitric and nitro-hydrochloric acids, or their salts, mixed with oil of vitriol, and alkaline leys, the oils being shaken with the acids and allowed to stand in vessels containing them, and then distilled. The purification of the oils with alkalies, which is particularly applicable to the less volatile fluids in coal-tar, particularly to that which is called "mortuole" in the specification, is conducted by digesting the oils with the alkaline solutions for a long time at the boiling temperature of the solutions, in an apparatus consisting of a boiler or digester, surmounted by a head or condenser, in which all the vapours are liquified again and retured into the digester.

The fluid called benzole is purified in different methods according to the purpose for which it is required. If required for the purpose of illumination, it is purified by simply washing it with acids much diluted; if required for refined uses, it is purified by treatment with concentrated acids, as described for empyreumatic oils in general; and is then further treated by refrigeration, by which it is solidified; it is then, while solid, submitted to pressure at a low temperature, by which means it is obtained quite pure, and is now called "absolute benzole."

The Third Part

Concerns the application of volatile hydrocarbons, and other spirituous substances containing much carbon, to the purposes of artificial light, by mixing their vapour with such gases or vapours as contain little carbon, so as to produce a white light without smoke. This is accomplished in two methods. The first is that of passing a current of atmospheric air, or of hydrogen, carbonic oxide, or other non-luminiferous gases, through reservoirs to which hydrocarbons or spirituous substances are supplied, which contain so much carbon and are so volatile as to give off to the current of air so much vapour that the air shall be enabled to burn with a white flame, at a burner at a distance from the reservoir. The hydyro-carbonous fluid preferred for this purpose is crude benzole, prepared from coal naphtha. The current of air, if atmospheric air be used, is obtained by any known method of producing a continuous flow of air through pipes, such as by bellows or pumps, working into "gasometers;" and the system is applicable on a large scale, suited either to the lighting of houses or towns, or on a small scale, in which the whole apparatus may be comprised in a table-lamp. A table-lamp is also constructed, in which the flame is made to supply itself, by means of its own draught, with the vaporized air which is burned.

The other method, in which the reduction of carbon is effected, is by mixing the volatile hydrocarbons with spirits containing less carbon, such as alcohol, or pyroxylic spirit, acetone, &c. Of these spirits, pyroxylic spirit is preferred on account of its cheapness; and different hydrocarbons are used according to the sort of lamp-fuel required. For vapour lamps or portable gas lamps, such as are already in use on the Continent

for mixtures of alchol and of oil of turpentine, benzole is preferred on account of its volatility. For camphine lamps or common Argand lamps the "camphole" made from coal-tar is preferred. For coarser lamps, the "mortuole" or rectified dead oil is used in the mixture. All that is necessary is to obtain pyroxylic spirit sufficiently free from water to enable it to dissolve the oils, and then to mix them in the required proportions, and to keep the mixture so that the spirit shall not evaporate. The proportions best for vapour lamps are, two parts by measure of pyroxylic spirit to one part of coal-naphtha or benzole.

The Fourth Part

Relates to the manufacture of lamps for the combustion of the mixture of volatile hydrocarbons and spirits described in the Third Part. The improvement consists of forming a burner which is either supplied by a wick which fits it, or by a small quantity of fluid kept at a constant level in the burner by pressure, so that the burner shall present a fine slit-orifice or jet for the escape of the vapour or gas, at which jet the vapour is to be ignited. These burners consist of two parts, a fixed wick-holder and a moveable cap, by the adjustment of which the size of the jet-slit is regulated. The burners are of various forms, and admit of various modifications; the principle, which is exhibited in the drawings attached to the specification, forming the subject of the claim. This part of the invention comprises also the adaptation to the wick-holder of a cone within the reservoir, so as to cover that part of the wick which is above the fluid and below the wick-holder, and thus to prevent evaporation from the surface of the wick.

The Fifth Part

Consists of an improvement in the construction of gas-burners, specially suited to the combustion of gas or air charged with the vapour of volatile hydrocarbons, according to the mode described in the Third Part, and also to the combustion of ordinary illuminating coal gas. The burners are such that the most perfect combustion and whiteness of the flame may be insured by the adjustment of a moveable part or parts of the burner. They admit of a variety of forms and constructions, and may be made as Argand burners or as single jets, drawings of several of which are attached to the specification. The principle in all is the same. One or more parts of the burner, which are caps made in the form of cones and cylinders, are made to be moveable by the hand on a fixed part, so as to regulate with great nicety the size of the orifice from which the gas escapes, by this means altering the luminosity of the flame, which is more or less luminous according to the rapidity with which the vapourized air or gas is brought into contact with the surrounding air.

GUTTA PERCHA PATENTS.—NO. XII.

[Patent dated December 30, 1847, for "Improvements in the Treating or Manufacture of Gutta Percha, or any of the varieties of Caoutchouc."* Patentees, Thomas Hancock, of Stoke Newington, and Reuben Phillips, of Islington, Chemist. Specification enrolled June 30, 1847.]

The patentees state that their improvements consist in the dissolving of gutta percha, or of any of the varieties of caoutchouc, or of reducing any of them to a soft, pulpy, and gelatinous state after they have undergone the process of "vulcanization or conversion;" also in preparing or treating unvulcanized or unconverted solutions of any of these substances, so as to bring them into a vulcanized or converted state; and, lastly, in the moulds employed in the manufacture of articles therefrom. The terms "vulcanized," or "converted," are used to designate certain processes by which these substances are rendered less liable to be injuriously affected by exposure to comparatively high temperatures, and which were described, the first in the specification of a patent granted to Mr. Thomas Hancock,† Nov. 21, 1843, and the second in that of a patent granted to Mr. Alex. Parkes, August, 25, 1846.‡

The patentees desire to be understood, that when employing the term gutta percha, or any of the varieties of caoutchouc, as referring to all those substances known to the Indians or natives of the country where they are produced under the names of saikwah, gutta tuban, gutta percha, jintawan, dollah, &c., and in this country of bottle, root, sheet, scrap, India-rubber, &c. In operating upon any of these materials, which have previously undergone the vulcanizing or converting process, it is preferred to use the cuttings or waste of them, as being an economical application of what would otherwise be useless. These cuttings, or waste, are first submitted to the action of rollers or other suitable machinery for reducing them to shreds and then boiled in oil of turpentine until reduced to the requisite consistency. Other solvents may be employed,

* In a former patent of Mr. T. Hancock's (see ante vol. xlviii., p. 452) the phraseology used was, "gutta percha, and any of the OTHER varieties of caoutchouc." We objected to this as conveying something contrary to fact, and are now glad to see that the mystification is not persisted in.—ED. M. M.

† See *Mech. Mag.*, vol. xlii., pp. 112 and 150.

‡ See *Mech. Mag.*, vol. xlv., p. 400.

such as coal naphtha, &c., but in that case, in order that the solvents may attain to a degree of temperature sufficiently high to dissolve the material, close vessels must be employed, for which reason oil of turpentine is preferred.

No fixed rule, it is stated, can be given for the guidance of the workman to enable him to determine the relative proportion of the material to the solvent, the time for conducting the operation, or the degree of temperature, on account of the varieties of the material and the degree of vulcanization or conversion to which it has been subjected; for these and other details he must rely upon his own intelligence, and the result of actual experience.

The rule which the patentees, however, state that they have found to be the best, under ordinary circumstances, is to just cover the material, when prepared and placed in the vessel, with the solvent, and then to add about one-third more, and maintain the mixture at the boiling point of oil of turpentine for about from 15 to 30 minutes. The consistency of the mixture may subsequently be increased or diminished by evaporating or by the addition of oil of turpentine, coal-naphtha, or other solvent. When the material has been rendered hard or horny by vulcanization or conversion, the time necessary to dissolve it or reduce it to a soft pulpy state would be so long as to render the preceding process worthless.

The mode of operating under the second head consists in mixing from eight to twelve parts of sulphur with every 100 parts of the solid material in solution, and then subjecting the mixture to the necessary degree of heat to produce the vulcanized or converted state.

The patentee mentions numerous applications of these solutions, among which may be cited waterproofing, and the employment of them as a medium for colours in painting and in printing calico, &c.

The improvement in moulds consists in making them of a material easily soluble at low temperatures, such as D'Arcet's metal, &c., so that they may be broken up and easily removed from the moulded article without injury to them.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Elizabeth Dakin, of No. 1, St. Paul's Churchyard, London, widow, for improvements in cleaning and roasting coffee, in the apparatus and machinery to be used therein, and also in the apparatus for making infusions and decoctions of coffee. July 3; six months.

Nathaniel Beardmore, of 13, Great College-street, Westminster, for certain improvements in founding and constructing walls, piers, and breakwaters, parts of which improvements are applicable to other structures. July 3; six months.

John Martin, of Killyleagh Mills, Down, Ireland, manufacturer, for improvements in preparing and dressing flax, tow, and other fibrous substances; and doubling, drawing, twisting, flax, tow, and other fibrous substances; and in the machinery to be used for such purposes. July 6; six months.

Joseph Clinton Robertson, of 166, Fleet-street, London, civil engineer, for improvements in the manufacture of gas. (Being a communication.) July 6; six months.

George Beattie, of Edinburgh, builder, for an improved air-spring and atmospheric resisting power. July 6; six months.

William Edward Newton, of Chancery-lane, Middlesex, for improvements in the construction of stoves, grates, furnaces, or fireplaces, for various useful purposes. July 6; six months.

Enock Steel and William Britten, of Lambeth, Surrey, manufacturers, for improvements in the manufacture of tobacco-pipes. July 6; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
June 29	1482	Henry Dunington	Nottingham	Hat-band.
30	1483	Francis Willetts Bassano	Birmingham	Roof-lamp.
July 1	1484	Robert and Francis Grassby	Marton, Hull	Thrashing-machine.
,,	1485	Davidson and Armstrong	Manchester	Spindle-valve for pumps.
,,	1486	Arthur Hill Holme	Liverpool	Improved safety-valve box for steam boilers.
,,	1487	William Hill	Greenwich	Flue boiler.
4	1488	Henry John Fry and Wm. Downs Phipps	Sloane-street, Chelsea	Elastic spring boot.
,,	1489	Charles Marben	Warren-street, Fitzroy-square	Saddle.
,,	1490	Woods and Thomas	Cheapside	Secure hook and flexible dress fastener.
5	1491	Charles Greenway	Park-street, Grosvenor-square	Stock.

NOTICES TO CORRESPONDENTS.

A correspondent would be obliged to "Forrester" to favour him (through our medium) with his address.

Mr. Dredge's paper on the Sea Wall question is witheld at his request, for the purpose of making some additions to it.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co. Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

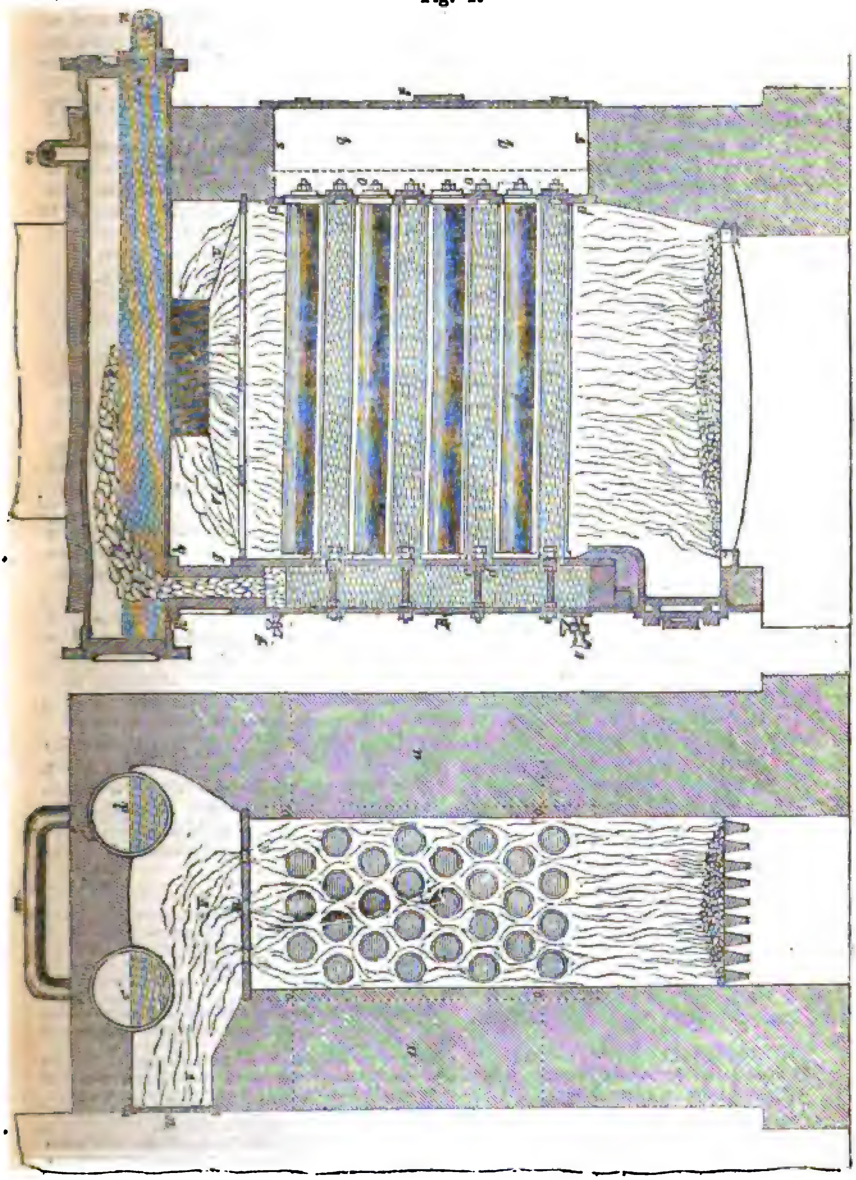
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1301.] SATURDAY JULY 15, 1848. [Price 3*d*., Stamped, 4*d*.

Edited by J. C. Robertson, 166, Fleet-street.

DR. ALBAN'S IMPROVED STEAM BOILER.

Fig. 1.



DR. ALBAN'S IMPROVED STEAM BOILER.*

The boiler is divided into three principal parts, viz:

(A.) The generating or boiling tubes.

(B.) The vessels which serve to lead the steam away from the tubes, and to supply them with water: these vessels I denominate *hearts* (*Herzen*).

(C.) The separators and receivers.

In order to facilitate the explanation I will first give a general description, and will subsequently explain the construction of the several parts in detail.

(A.) The *generating tubes* are formed of sheet copper, one line in thickness, and joined with hard solder (*Schlageloth*). They have 4 inches external diameter, and may be from 4 feet 3 inches to 6 feet 3 inches in length, as more or less heating surface is required. They have at the back end an opening for cleansing them, closed by a screw cover. Their front ends are screwed upon the back plate of the *heart*, in such a way as to be easily removable in case of necessity; as, for example when a tube is worn out and has to be replaced by a new one.

The interior space of the tube communicates with that of the *heart* by two oval openings bored through the back plate of the latter, one above the other. The upper one serves to carry away the steam from the tube to the heart; the lower one, to introduce the feed water in a contrary direction. In order to give the vapour a tendency to stream towards its exit openings, the tubes are laid a little on the incline, the back end being, in a length of 4 feet, about half or three-quarters of an inch lower than the front end.

Figure 1 is a longitudinal section of a boiler and furnace on this principle, the dimensions being given for a boiler of 10 horse-power. A A, are the generating tubes; *aa*, their back or lower ends, shut by the screw covers; at *b b* they are connected to the back plate of the heart, B; *c* and *d* are the oval openings between the hearts and the tubes. The inclined position of the tubes is seen in this figure.

I lay the tubes in eight rows or tiers, one over another, and in such wise that the tubes of each row stand over the interstices between those of the row immediately below.

Four alternate rows consist of one tube less than the other four, this inequality being a consequence of the position: I arrange them in such a manner that the lowest row has the greater number. The space between the tubes I have made about 1½ inch (*a*). Between the outside tubes of the widest rows, and the vertical walls of the furnace, I allow three-quarters of an inch space. The manner in which the fire current plays among the tubes is easily seen in the figure.

The *hearts*, as I term them (*b*), are flat chambers, from 6 to 8 inches deep. Their height in the clear should in all cases reach 40 or 42 inches; their width depends on the number of tubes in the several rows; the rule obtains that they should be from 8 to 12 inches wider, in the clear, than the outside width of one of the widest rows. The object of this will appear presently. The hearts are constructed of iron; their sides I make usually of cast iron, of such strength as to remove all danger; wrought iron, however, may be used. The front and back plates are of very strong wrought iron plate, the former ½ inch, the latter ¾ inch thick. They are so tied together by several rows of strong iron bolts, that no bending or bulging out is possible (*c*.) They are also screwed to the side plates with a proportionate number of bolts, equally strong. The joint is made for the back plate with the ordinary iron cement, and for the front plate with lead, as the latter has to be opened for cleaning.

The hearts have the form of a rectangular parallelogram, with the angles of the interior a little rounded. In most cases their height is greater than their width, inasmuch as a greater number than six tubes in one row is not to be recommended.

The generating tubes fit into an annular groove sunk in the back plate of the heart. The oval openings which form the communication between the heart and the tubes, must come as close as possible to the upper and lower surfaces of the interior of the

* From Parts III. and VI. of Dr. Alban's work on "The High Pressure Steam Engine," just published by Mr. Weale. We reviewed Parts I. and II. at the time of their appearance—see vol. xlvi., p. 569—and shall take an early opportunity of bestowing our critical attention on these concluding parts.

(*a*) I have more lately found that this distance may be increased with advantage, to facilitate in a greater measure the cleaning of the spaces between the tubes. I purpose to increase it to 2, or even 2½ inches, and to provide openings in the side wall of the furnace, through which proper instruments may be introduced for the purpose of cleaning. They must, of course, be tightly closed when the furnace is in action.

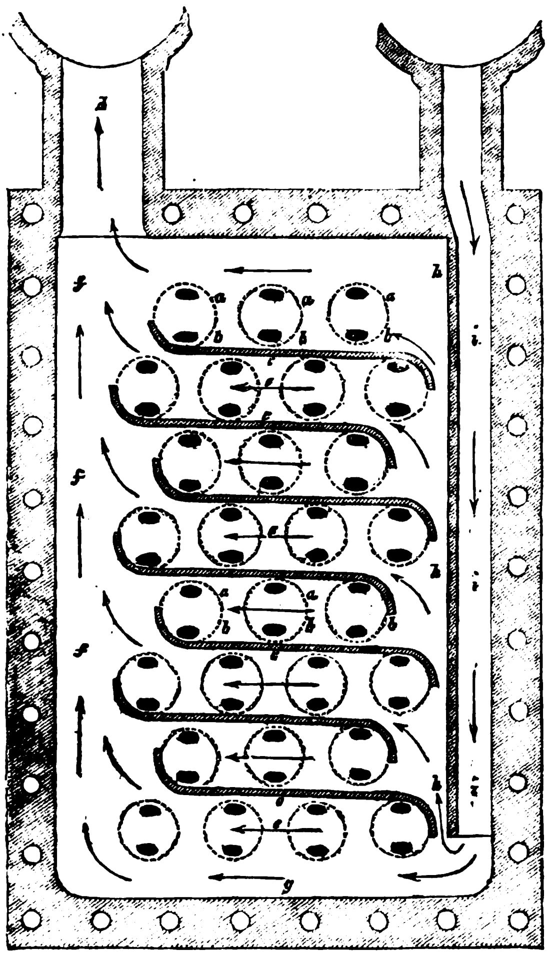
(*b*) This term appeared to me suitable, because these parts are the means of producing a proper circulation of the water through the tubes and other parts of the boiler, in the same manner as the heart is of the blood in the human organism.

(*c*) I have never found the least bulging of these plates, even with a pressure of 150 lbs. to the square inch.

tube: this is particularly necessary with the upper openings, in order that the steam may pass freely away. The size of these openings is 1¼ inch in the longer and 1 inch in the shorter diameter. The manner in which the tubes are secured to the heart is explained further on.

The internal construction of the heart is peculiar, and of much importance. It is shown in fig. 2 in longitudinal section, looking towards the back plate and the tubes, the latter being represented by dotted lines: *a a* and *b b* are the upper and lower oval openings leading from the heart to the tubes.

Fig. 2.



The upper one, which may be called the *steam opening*, is to allow the steam to pass from the tubes to the heart; the lower one, or *feed opening*, is to introduce the feed water in the opposite direction. *c c c* are division plates, of strong wrought iron, fastened steam-tight to the back plate by small ears and screws, and projecting so as to form also a joint as nearly tight as possible with the front plate (*d*) when this is screwed on: these plates are curved in the form shown in the figure, dividing the heart into several channels, *e e*. The use of these divisions is to guide the steam issuing out

(*d*) If this joint should not be perfectly tight, it is of no serious consequence, as experience has shown.

of the steam openings, *a a*, into the vertical channel, *f*, and to keep it out of the way of the feed openings, *b b*, that the proper water supply may not be interfered with. The width of this channel, *f*, depends upon the number of tubes in the rows. I allow for every tube in one of the widest rows, one inch width of channel. The steam passes, carrying usually some water with it, from the channel, *f*, up the pipe, *d*, into the separators.

It remains to show how the circulation is completed: *i* is a pipe (which, when the sides of the heart are of cast iron, may be cast with them) passing vertically down the side opposite the pipe, *d*, and opening about 3 inches from the bottom of the vessel; through this a stream of water constantly descends from the receivers above, turning up the channel, *h*, and gradually supplying the place of that carried away in mixture with the steam, as well as introducing itself through the feed openings, *bb*, into the tubes, to supply the evaporation. The arrows in the figure will clearly explain how the circulation proceeds, and it will easily be understood how the steam, collecting by its own levity in the upper part of the chambers, *e e*, is guided away by the peculiar form of the division plates, without interfering with the water in the lower part of the chambers, or impeding the flow of the supply to the tubes. The steam, as may easily be imagined, carries upwards water mechanically mixed with it, and this is supplied by a gradual reflux, partly from the space, *g*, and partly from the chambers, *e e*.

The depth of the heart from the front to the back plate should be such that the steam may not form too deep a sheet at the upper part of the chambers, *e e*: I allow for every tube in one of the widest rows 1½ inch depth of the heart. Some space should be left at the top and bottom of the vessel, the former serving for steam and the latter for water room.

e is a stop-cock for emptying the boiler: *f* is a smaller one, situated 1 inch above the level of the uppermost row of tubes; it serves as a gauge-cock in case of the usual water gauge in the receiver standing very low, and when doubt is entertained (before fire is put under the boiler) whether any of the tubes are dry. If water flows from this cock, the vessel may be heated, especially as the level rises when the water begins to boil.

From the upper part of the *heart* rise two pipes, of which incidental mention has already been made. One of these serves to carry away the steam from the heart into the separators; and its cross section, an oblong rectangle, must have its dimensions proportionate to the steam-generating surface of the tubes; namely, for every 10 square feet of surface, the pipe should have about 1 square inch area in the clear. This pipe has a curved flanch by which it is fastened with screw-bolts to the separator, and the joint made tight with iron cement. If the sides of the heart are of cast iron, this pipe, as well as the following one may be cast upon them.

The other pipe is of smaller area, viz. 1 square inch to every 25 square feet of heating surface. In every other respect it resembles the former one. Its use has been already explained, namely, to lead back the water into the *heart*. When the sides are of wrought iron, this tube must be a separate wrought iron one inserted into the heart, and reaching nearly to the bottom.(*e*)

The *separators* and *receivers* are always of wrought iron, formed of plates one-fourth to three-eighths of an inch thick, well riveted together, and provided with strong cast iron end covers, similar to those in my first-described boiler. The diameter of these vessels must never exceed 18 inches, this size being sufficient for the largest boiler.

If only one heart is used, one separator and one receiver of small diameter are sufficient; but when much power is wanted, it is better to make use of more hearts than to increase the number of tubes beyond six in each row; two of these with tubes 6 feet 3 inches long, and six in number in the lowest row, furnish steam enough for an engine of 60-horse power.

The separators and receivers are both of equal dimensions, and are placed horizontally, as shown in the figures. The pipe which conveys the steam from the heart enters at the front end of the separator, *c*, while the steam and the water are carried from the back end into the receiver *d*;—the former by the pipe *m* connecting the upper part, or steam space, of the two vessels together; the latter by the tube *n*, forming a communication between their lower or water spaces. Both those connecting tubes are of equal area, namely, 1 square inch to 25 square feet of heating surface of the tubes. The steam is carried to the engine from the front end of the receiver, while the water descends, also from that end, by the pipe *b* into the heart, to supply the place of that evaporated and carried up in mechanical mixture with the stream. The receiver is also provided with a safety-valve or valves, and an index float, all similar to those formerly described. These as well as

(*e*) These two pipes might, to keep up the analogy, be called an artery and a vein respectively.—Tr.

the steam-pipe should be as near the front end as possible, where the water is most at rest.

The dimensions and proportions of the separators and receivers depend on the cubic content of the hearts. I have adopted very simple rules on this point, and have found them to answer all my expectations and requirements, although this boiler is yet comparatively in its infancy. As far as my experience has at present gone, I recommend that the cubic content of the separators and receivers combined, should be equal to the sum of that of the hearts and generating tubes. The length should exceed that of the boiler-tubes by one-half, and when much room is required, the number should be increased, rather than that they should exceed 18 inches in diameter.

A large boiler of this description, which I have already constructed for an engine of 30-horse power, has two hearts, each with twenty-eight tubes, lying in eight rows, one above another; and I have used two separators, with a single receiver between them, and connected with the hearts. This boiler has not only fulfilled, but far exceeded my expectations; the heat is so perfectly applied, the steam production so regular, the water level so quiet, and the whole so safe, trustworthy, and convenient, that its advantages in these respects can seldom be equalled in the most perfect boilers of the ordinary construction.

The action of this boiler has already in a great measure been explained. The tubes abstract the heat from the fire current passing among them, and impart it to the water within. The steam collects in the upper part, and passes through the upper oval openings into the heart; an operation facilitated by the inclined position of the tubes. The steam having reached the interior of the heart, follows the direction given it by the division plates, flowing upwards and sideways in the canal, *f*, and thence by the pipe, *d*, into the separator. When the dimensions are suitably proportioned, this goes on without much disturbing the water in the lower part of the channels, *e e*, which constantly covers the lower oval opening, allowing the water at all times to flow into the tubes to supply the evaporation. This water may, however, gently follow in some measure the direction of the current of the steam, being supplied constantly afresh from the canal, *h*, and pipe, *i*. The steam, when it reaches the pipe, *f*, rises unhindered through that and the pipe, *d*, into the separator, and in so doing carries water along with it, causing a strong ebullition in the fore end of the separator. Since, however, the water surface in this vessel is of considerable extent, the steam, passing towards the hinder part of the vessel, finds room to develope itself, separating continually more and more from the water, and at the back end this separation becomes complete. The steam and water then pass quietly through their respective pipes, *m* and *n*, into the receiver, in which a perfectly quiet water level is maintained, both fluids moving gradually towards the fore end, where the steam is carried off to the engine, and the water is returned to the heart, to pursue its labyrinth-like way as before. The water thus follows a constant circulation, from the heart into the separator, from this into the receiver, and back into the heart again.

I have found this arrangement perfectly satisfactory, not only in preventing water being carried with the steam to the engine, but also in retaining a perfectly quiet water level in the receiver, even when the water surface bore but a very small proportion to the evaporation. How seldom ordinary tubular boilers fulfil these conditions is well known.

WALKER'S PATENT HYDRAULIC ENGINE.

We had the pleasure of inspecting this week a hydraulic steam engine of a new construction, lately patented by Mr. John Walker, already so well and favourably known to the public for his water elevator and other clever hydraulic contrivances (see vol. xli. 373—390, vol. xliii. 430.) Within one framework, covering a space of no more than 4 feet square, there is included not only the hydraulic engine itself, but a steam engine for working it. There are two steam-cylinders, each 11 inches in diameter, and immediately beneath them are two water-cylinders, each 24 inches in diameter. From the cross-heads above the steam-cylinders, and attached to the steam-pistons, connecting-rods pass down, and are bolted to platforms which carry the water-pistons. The water-cylinders are open at the bottom, and are immersed in a cast-iron well, fitted with sluices, to admit water applicable for draining. The water-cylinders terminate at the upper part in a capacious valve-box, communicating with the delivery-main, which is also furnished with sluice-doors for discharging the water inland or outwards. The valves in the water-cylinders and pistons are of a novel and excellent construction; consisting of a large number of rolled iron tubes, which lie in circular seatings across the piston, rising and falling in guides which limit their motion. By this arrangement a very free passage is afforded to the water, and the valve acts without the slightest shock, even when the engine is working at a high velocity. The steam-cylinders are single acting, steam being admitted alternately

between them, by a slide-valve worked by an eccentric on the crank-shaft, which connects the two steam-pistons, and carries a fly-wheel to regulate the action of the engine.

With the steam at a pressure of 35 lbs. per inch, an engine of this sort is stated to be capable of raising no less than 6,000 gallons of water 8 feet high per minute; and Mr. Walker is in the habit of contracting with his customers that such shall be the duty performed.

The great power of this engine, combined with the simplicity of its action and small liability to derangement, recommend it as peculiarly suitable for drainage and irrigation; operations which are commonly most required where expert hands are scarce. A common farming labourer may be made a perfect master of such an engine as this in a week's time.

CUTLER'S PATENT LAP WELDED IRON TUBES.

[Patentee, Job Cutler, of Birmingham, C. E. Patent dated January 13, 1848, for certain Improvements in Welded Iron Pipes or Tubes to be Used as the Flues of Steam Boilers. Specification enrolled July 13, 1848.]

The patentee states that the object of his invention is to produce lap-welded iron tubes or pipes, so formed as to give increased strength to those parts which are exposed to wear, without additional weight to the entire length of the tube, and thereby to obviate the evils to which boiler tubes are at present exposed. He proposes to effect this by making the internal diameter of the tube greater at one end than at the other, instead of its being the same or uniform throughout, as has hitherto been the case; the *external* diameter remaining, however, the same, and uniform throughout the entire length of the tube. The tube will, of course, be cylindrical upon the exterior, and conical upon the interior surface. The increased thickness of metal at the one end is to be drawn from the remaining portion of the entire length of the tube. And further, the operation is effected at one heat, so that the ductility of the iron of which the tubes are composed shall remain unimpaired.

The *modus operandi* is as follows:—The patentee employs a series of grooved rolls, moved by suitable toothed wheels and a mandril, with a conical bulb or head, the stem of which is of increasing diameter towards the opposite end. The skelp, after being properly prepared, as is usual in the manufacture of lap-welded iron tubes, is heated and passed between the first of the series of rolls. It is then welded over the conical bulb and forced, at the same time, over the stem of the mandril. The mandril is held by a grip, attached by a hinge thereto in a stop, so as to allow of its being lowered and passed, after the conical bulb has been removed, between the second series of rolls; the diameter of the groove of which is smaller than that of the first series. The tube, with the mandril still inside, is then passed through the third series of rolls; the groove of which is smaller than that of the second series. The object of these successive rollings, after the skelp has been welded on the mandril, is to remove any irregularities upon either of the surfaces, and to make the edges of the tube perfectly smooth and uniform. The tube is then taken to the drawing bench, in front of which is a stop, and against which the pipe rests. The stop is furnished with a hole to allow of the passage of the grip of the mandril, which is held tight by a pair of pliers, and, the bench being made to move while the pipe remains stationary, the mandril is withdrawn.

When it happens that the mandril adheres too lightly to the tube, it is proposed to heat it in a muffle or furnace, then to cool the end which rests against the stop, and repeat the above operation, or to roll it cold between three rollers, as is usually done in straightening shafting.

THE MODEL LODGING HOUSES FOR THE WORKING CLASSES.

To the Lord Ashley.

My Lord,—Report speaks of you as a "proud, good, honourable man." You have found fame throughout the land—fame for benevolence; but that is a very cheap virtue—scarcely a virtue at all, it is so much of a pleasure. He must be a horrible tigrine beast who feels pleasure in malevolence, to say nothing of the trouble it must give; but benevolence is really so easy, so pleasant an after-dinner, wine and walnuts accompaniment, such an ornament of the tea-table, that I cannot conceive a gentleman willing to exist without it. To pat a chubby ploughboy on the head, or vituperate "Moses" in behalf of distressed sempstresses, is positively amiable, and at the same time pleasant exercise. There can be no doubt about the benevolence.

Beneficence, my Lord, is a virtue of another character, of much sterner stuff—it is the difference between willing, or rather wishing and doing, and not merely doing, but doing effectively. When the warmth of your temperament prompted you to embark in the needlework line for the purpose of shaming Moses by your higher wages, you gave much gladness to those you employed, for the time you employed them, and to the numerous class of benevolent people far and near, who found in your deeds subject for much pleasant conversation. But it did not last, it could not last, for it was based on a fallacy; your *doing* was not effective,

your money was wasted, and your intended beneficence proved to be only a benevolence, raising false hopes which were doomed to ultimate disappointment. Beneficence is not *dilettante* work, whatever benevolence may be, saying nothing of ostentation.

A gentleman named Brooke, under the impulse of benevolence, embarked his private fortune in a ship and crew, and, unaided and unsanctioned, save by his own great heart, determined to rescue a race of savages from the thraldom of ignorance and vice, and found a new empire. With courage undaunted, intellect unclouded, skill rising with the emergency, he was successful in his enterprise, and became an eastern prince by the voluntary election of the people. *He* was a truly beneficent man. Britain hath no worthier son than he—though many bishops.

Creditable is it to you, my Lord, that after your failure in the needle line, you did not turn away in disgust from the work of doing good. You had taken pains to ascertain that the condition of the working classes was not favourable to the development of the domestic virtues, and you were determined to do what in you lay to improve their condition. It is not expected that a nobleman should know much, about how the constructors of his house and furniture may live; but you, my Lord, waived that privilege of your rank, and not taking the word of the physician, examined for yourself. You were convinced, and determined to join others in an act of true beneficence—helping the poor to help themselves, in order to cease to be poor. You resolved to build a pattern lodging house. The resolve has been carried into execution, as I find by the papers, and if in criticising it I happen to err, the fault must rest with the reporter, as I am not at present enabled to examine the building.

Your site is chosen on unmitigated London clay, about 300 feet above the water springs. It is near old St. Pancras burying ground, not a favourable locality for health, if the funerals are continued now as formerly; but the site is cheap, and perhaps your influence will get the nuisance of the burial ground abated. It is not a good neighbourhood. True it is, that the poor cannot expect to be located in Hyde Park Gardens, but there is land enough in the vicinity of London of a healthy character, and far cheaper than that you have chosen, were due advantage taken of modern appliances, in the shape of railways, to get access to it.

Your plan, my Lord, is by no means new. Twenty years ago it was proposed in the *Mechanics' Magazine*, on a larger and more comprehensive scale, under the title of "Better Housing the Working Classes."* But it is not to be expected that your Lordship should have read the *Mechanics' Magazine* in those days. The first person who practically put such a plan in operation was, I believe, Mr. MacGregor Laird, at Birkenhead. The houses there are not quite earthly paradises more than those of your Lordship, but, compared with the dwellings of the working classes in Liverpool, samples of the "wisdom of our ancestors," they are practical paradises. Times have not been favourable since their erection, but they are thoroughly appreciated. The present writer remembers a case of a labouring man who lived in a festering den called a cottage. The agent came to demand rent: "Rent!" exclaimed the man, "you ought to pay me for trying to dry the place. Why I grow mouldy as I lie in bed." The Birkenhead dwellings are thoroughly dry, but occasionally the anti-rent principle of Ireland obtains there. Irish lodgers get in possession, are more comfortable than ever in their lives before—pay no rent—take the full benefit of the English law that "every man's house is his castle"—and smile contemptuously at any agent seeking to dislodge them. "The world is not their friend," and that is the first "world's law" they ever found benefit from. I trust you will not be disheartened, my Lord, should you occasionally meet with lodgers of this description. As we sow so must we reap, and the dog that has been often beaten will occasionally snap at the hand that merely seeks to caress him. You are on the right track now, away from the false lights of the Needles, though still several points out of your true course, which leeway you will have to fetch up.

The impetuosity of compassion has prevented you from ascertaining the best mode of accomplishing your object, as the charitable lady, when in a hurry, gave a cheesecake to a starving chimney-sweep, instead of its value in bread. Shall we begin at the beginning, and endeavour to ascertain what are the requisites for "better housing the working classes," or rather the *best* kind of dwellings for the working classes—a piece of knowledge which, if it can be attained, may be of very great service also to the non-working classes who may wish to attain the maximum of personal comfort, with the minimum of labour to the working portion of the community. Of course, we do not include that portion of non-workers who experience a morbid delight in catching a white man, and coloring his externals in the worst possible taste, his lowest extremities black, an adjacent portion white, break-

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* *Mech. Mag.*, vol. xvi., p. 165.

ing away in the mid-districts into vermilion, fading above into yellow, and the whole surmounted with sky blue. It is certainly not good taste to convert a man to a bad likeness of a parrot; but as it must be evident that such persons are desirous only to attract attention by externals; of course the greater number of persons they can employ uselessly, the better will their object be attained. With them your Lordship can have nothing in common. "My gracious!" said an urchin of New York on beholding an English carriage with three footmen in livery, "well if it doesn't take three Britishers to make a nigger!"

A human dwelling requires the external walls to be of considerable thickness in a climate like that of England, to exclude cold in winter and heat in summer; and if the walls can be made hollow, with air enclosed in the spaces, this object will be best attained. Here, however, the wisdom of our ancestors interferes—the venerable brick duties prescribing, Mede and Persian fashion, that the sizes shall be no other than 9 ins. × 4½ ins. × 2½ ins. Nothing larger shall be made, say our brick Solons; and thus, as was the case with glass, improvement is arrested on the threshold. That legislator who shall abolish this monstrous folly, will be looked up to ever after, and regarded by the productive classes as a veritable "brick"—the brick of bricks—the brick without end—as the vernacular has it. The good that will result from such an achievement will entitle any legislator of moderate capacity to repose on his laurels for the remainder of his life, and have a column of imperishable brick erected to him after his death; for such will bricks be, when skill and industry are freed from their shackles. Your endeavours are arrested *in limine*, my Lord, and you must lay close siege to this evil ere you can bring house-building to perfection. About it, then!—gather all the brick-makers and brick-users around you, and cram the "House" with the mass of complaints with which they will furnish you to serve as a groundwork for a sweeping brick act. Stick to the bricks, and confine yourself to simple abolition of all and everything relating to them. Resolve them into the condition of brick-earth, to be dealt with by brick-makers.

I did not reflect how far my path would lead when I began to address you, but being now too far advanced to retreat, I must go on. The best and most durable bricks that are made, are the "Staffordshire blue bricks." They are half metallic, half vitreous, and consequently they are non-absorbent. They are as durable as glass; but the mode of using them is not analogous to their texture; they are put together in walls with common mortar, and there is no bond, as when bricks and mortar are alike porous. The mortar merely serves as a kind of plaster cast to them: as a sound material, nothing can be better.

There is a certain thickness of material beyond which fire cannot penetrate without great cost. The ordinary brick in use has attained this limit. But if the bricks were made in the form of a box, with one side open—say two feet long, one foot wide, and one foot deep, the thickness of the material being two inches, these large bricks could be fired as easily as the small ones. Bricks thus made could be formed so as to groove or tongue one into the other; and with a little arrangement of shapes for angles and openings, hollow walls could be built of greater strength than solid ones, perfectly impervious to water, and requiring very little cement to make them air-tight; and such cement, besides being waterproof, should be of a slightly elastic material, as asphalte, or a similar substance, in order to prevent cracking. The sides of these bricks should be roughened for the plaster, and some should be formed with projecting string courses whereon to lay the floors.

At present it is a practice to place a layer of asphalte beneath the foundation of the walls, to prevent moisture from rising. This on account of the porous nature of the bricks. But the bricks are equally exposed above the foundation to the moisture of the earth and to the rain above the earth. Bricks made of non-porous materials are free from this objection.

In order to have health in a house it is necessary that it should be warm and dry. These two conditions are precisely those essential to combustion. It is well known that of late years many public and other buildings have been burned down more frequently than formerly. The cause of this is, that houses and public buildings were formerly constructed with little regard to comfort, and, being damp and cold, did not readily catch fire. This is mostly the case with the dwellings of the poor. Since then they have been artificially warmed in various modes—by stoves, hot air, steam, and water pipes—and being warm and dry, are, like tinder, ready to catch. The only remedy for this is, to make them fire-proof, *i. e.*, to construct of metal, stone, brick, tile, or slate those parts which are usually made of wood. To build a new house of combustible materials now, and afterwards to insure it, is an absurdity that can only arise from the circumstance, that houses are mostly made to sell by speculating builders, and not as investments.

There are two kinds of fire-proof build-

ings, one kind in which there is no combustible material whatever, the other, in which every apartment containing combustible materials is separated from every other apartment by non-combustible materials.

Beyond dryness and warmth there is another essential consideration—ventilation. Moist exhalations are continually proceeding from human bodies as well as breathed air, and without perfect ventilation these cannot be got rid of.

In warming there are two considerations. The air for the lungs requires to be warm and pure; but the air which is pleasant to the lungs, will not suffice to warm the exterior of the body and keep up the circulation in sedentary people. For this purpose, the radiant heat of an open fire is essential.

The warm air should be a genial atmosphere pervading the whole building—the open fires confined to particular localities.

The next consideration is light. This can only be well attained by making the width of the street at least twice the height of the buildings. The artificial light should be gas.

The next consideration is water, both hot and cold. This should be carried to the very top of the building by machine force, and allowed to descend by its own gravity, distributing it as required.

For the purpose of moving fuel, food, and other weights, there should be machine lifts from the bottom to the top of the building, and light iron rails inserted in the floors of the passages to run the baskets or boxes on.

Easy stairs should be provided for ascent to the upper stories; but, inasmuch as the higher stories are the most healthy, and the more stories the less proportion of roof, it is desirable to have many stories, as in Paris or Edinburgh; and to obviate the only objection to this, machine lifts should be provided, constantly ascending and descending at a slow rate. Londoners will have an idea of this from the plan of the Colosseum.

To build on the small scale is far less economic than on the large, as it would limit the advantages. For example, a steam engine is essential to the establishment for many purposes of labour-saving. As you, my Lord, and your colleagues, are powerful enough, of course you will be willing enough to set the best example. I will proceed on the larger scale with a building for the working classes in a manufacturing district, whether of food, clothing, or other articles. In the mean time, you will remember, not the "first mover," but the first fixture—the bricks! Do by them what Sir Robert Peel has done by the glass. And will you excuse my suggesting to you that the best mode of ascertaining what are the needs of those who are their own servants and helpers, is, to make the trial in person? Surrounded by servants to forestall every wish, appliances of every kind to administer to the most refined luxury, it is not possible to carry in the imagination all the innumerable details which are essential to make up that luxury. Were you to put yourself for a week into the position of the Douglass moss troopers, when

> "He that had a bonny boy
> Sent out his horse to grass,
> And he that had nae bonny boy
> His ain servant he was;"

—at the end of the time you would doubtless know the wants of a groom. Try the lodgings for a week, my Lord. No help but your own hands and head, upon your honour.

I think you will agree with me that in certain things the handworkers of the community are entitled to have an equal share with the head-workers or leisure classes, precisely as the officers of a ship are entitled to no better rations in the common stock than the crew of that ship. What the officers have in addition is a question of luxury, but the commoners ought to be provided with food and warmth to enable them to maintain good bodily health, a larger allowance being given when under hard work.

So in our proposed building, which is for numbers and not for ships' crews, the arrangements must be favourable to a good development of health both in the adult and those new-born and growing up. The physical acquirements are good air, dry air, warm air; good water, hot and cold in abundance; space for exercise in bad weather; convenience for privacy or society at will; arrangements for stowage of provisions, and also for cooking them with the minimum of labour; artificial light.

The mental arrangements are, a library and reading room, a school-room, an infant school. A lecture room also.

Without these latter arrangements, peace will not exist. "Idleness is the root of all evil." Mischief is a word used to signify unoccupied energy; and the active human mind, when not occupied in acquiring or producing, takes to thieving or destroying. Unoccupied village boys rob orchards and hunt cats and other animals. Respectable ladies rob shops, being acquisitive like magpies. Gentlemen hunt foxes, shoot partridges, "punch heads," wrench off knockers and bell-handles, and pull down direction-posts and sign-boards. They are all badly educated and prefer doing mischief to doing nothing. "Idleness is the root of all evil." But it is not sufficient to set this for a schoolboy's copy, unless we provide

also for the exercise of pleasurable industry.

We will suppose a piece of land secured on the borders of the South Western Railway—gravel soil for the workers for once, my lord—till Edwin Chadwick, studies a little better how to manage the clay—say in the neighbourhood of Battersea, Wandsworth, or Wimbledon; and that Mr. Chaplin has bound down the Railway and its heirs for ever, not to raise the fares on the working man, who will be willing to pay a fair price for the accommodation afforded, and trust that the Company will go as low as they can in consideration of the numbers.

On this land we will lay out a building in the form of a hollow square containing a courtyard measuring 400 feet on each side externally, and 300 feet on each side internally, the buildings being 50 feet in width from front to back. The buildings to be eight stories in height, including the ground floor—the average height of the floors eight feet, some more, some less. Dry cellars to be constructed beneath them for the deposit of provisions, such as grain, potatoes, and other vegetables. In the centre a tall chimney shaft to be erected, capable of carrying off the smoke of all the boiler fires in the establishment. Around this shaft to be erected a building of 125 feet square—a ground floor only lighted by skylights—and with cellars beneath for coals. This building to be divided into compartments, containing a boiler-house with boilers of proper capacity to furnish steam for an engine of sufficient power to pump up water from a well to supply the whole establishment at the height of the upper story. The boilers also to supply hot water, and steam pipes over all the building in proper positions, and also the wash-houses and baths, which will be in the same building as the boilers. The space around the courtyard between the centre and external buildings will be about 85 feet wide, laid out with grass plots and flowers. If the space in the central building be not sufficient for all the baths, a portion of the cellars may be applied, properly fitted up. If the water be hard, arrangements can be made to preserve the roof water in under-ground tanks.

The floors to be formed of wrought-iron girders, with a broad lip below and above. The centres of the girders to be supported on iron columns having a space of 10 feet between them. The ceilings to be formed of slabs of sawn slate in 6 feet lengths, stretching from one girder to the other. The floors to be of similar slabs of thicker substance having a hollow space equal to the depth of the girder between them. In these hollow spaces the stone pipes may be placed, and the whole floors may be reservoirs of warmth beneath the feet, and to which the warmth may be admitted or excluded at pleasure, beneath each apartment. To these stone pipes steam taps should be attached in each apartment, affording the means of warming liquids at pleasure, making tea or coffee, boiling milk, stewing fish, flesh, fowl, or vegetables, preparing a foot bath or shaving water at any hour of the day or night. Each apartment to be divided by slate partitions, but the doors to be of wood, and to have a floor area about 16 feet × 20, subdivided into a sitting room, 10 feet × 20 feet,—a bedroom 6 feet × 12 feet,—and a closet with sink, &c., and cold-water tap with a gas light. The gas and water pipes to be laid in the hollow of the floor, the slating being capable of removal at any time to get access to the pipes. The windows hung upon a horizontal swivel, the upper part towards the ceiling running inwards, the lower part outwards. No opening to be provided in these apartments, as the warmth and chimney ventilation will be sufficient for persons not of sedentary habits, and the convenience of the steam and gas will be sufficient.

It will be obvious, that a building so constructed cannot be burned down, and will be thoroughly dry and warm; so there will be no insurance to pay. It will be obvious, also, that no vermin can exist therein, and that the greatest possible facility of cleansing exists. The hot steam and water furnishes instantaneous means of cleansing the floor or walls at any time, and at the same time of drying them.

Six stories would be appropriated to those apartments. The buildings being 50 feet wide, there would be a central passage 10 feet wide between the rows of columns, and the apartments would front each way. There would be about 160 apartments on each floor, making, with the six floors, accommodation for 960; or taking a portion of the lower floors, say 1,000 families, averaging four persons each, say 4,000 men, women and children. That, my Lord, would be a number well worth your attention. If the purpose be good, the good would be in large amount. The cellars below should be fitted up for provisions in the following mode:—Cast-iron tanks, similar to gas tanks, covered in at top, all but a man hole, fitted with an air-tight cover, or air-tight brick or stone tanks of a similar kind, being provided of fitting size, green vegetables, fish or flesh being put into them, and the cover fitted and luted with gutta percha, or similar material, an air-pump is to be applied connected with the steam engine, and the air exhausted. Neither decompo-

sition, nor vermin, nor thieves can affect provisions thus stored, and the only care required would be to try the air-pumps occasionally to make sure against leakage.

A certain portion of the lower story on each side the main gates would be appropriated to the officers of the establishment. Another portion would be a dining-room, a coffee-room, a library, a lecture-room, and a reading-room — perhaps a music-room also; 1,600 feet × 50 would afford ample space. All these rooms would be furnished with fire-places as well as warm air, and the flues would be let into the main chimney shaft.

The kitchens would be on the upper story. The whole north side 400 ft. × 30 ft. would be applied to this purpose, and small steam-engines supplied by the pipes from below would perform all the drudgery, and cleansing of plates and utensils, chopping wood, &c. Open fires, steam-boilers, gas-meters, would do all that was requisite. Hoisting and lowering tackle worked by the steam engines, would supply the kitchen with uncooked articles, and transport them cooked to their destination. Air-tight receptacles worked by the same engines might also be placed in the kitchen. In this mode the building would be free from all unpleasant scents. A portion of the space next the kitchen might be used for an upstairs dining-room for women and children.

The southern side of this upper story would be a school-room. The western side an infant school-room, and a portion of it might be a greenhouse with skylights. The eastern side might be applied to bed-rooms or other purposes. Of course all debris and useless water would be carried down proper shoots.

The staircases would be of slate, fire-proof like the rest of the building, and easily cleansed. There would also be four engine lifts, one at each angle constantly raising and lowering.

It would be desirable to furnish the building with every thing requisite in the shape of bedsteads, tables, chairs, &c., so as to prevent all transport of lumber in and out.

Attached to the engine house there might be some horizontal shafts provided with circular brushes, to do all the shoe-cleaning of the establishment.

The gas would be manufactured on the establishment, and the coke would serve to feed the engine and other fires. The time will come when the nuisance of gas work chimneys will be abolished in cities by the gas being made in the coal pits beneath the earth, and conveyed in pipes along the railways.

With regard to the smoke from coal, that will continue till some shrewd manufacturer gets the proper chemical analysis of cannel or other coal that burns with perfect combustion, and, mixing the varieties of other coal artificially, produces the same result. To use crude coal for our fires is as ignorant as it would be to use crude potatoes for our stomachs.

And now, my Lord, with regard to figures —to the question "Will it pay?" For unless it will pay, it will be of no possible use. It can prove nothing practical of a new kind, because every single proposition herein has been in actual practice in other forms, though as yet uncombined to produce this result. Will it pay, my Lord?* I think it will. Twenty horse engine power and all.

Take the apartments all round at 150*l* each, say 1000 in number, that will be 150,000*l*.

Interest, at 7½ per cent. per annum	11,250*l*.
These apartments, with furniture, fire, warm air, gas, water, &c., would be cheap at 7s. per week, or 18*l*. per annum. Annual revenue	18,000*l*.
Expenses and profit	6,750*l*.

Nothing taken for use of baths.

If you work not for profit, but for investment, then the profit will pay Mr. Chaplin's constituents for the use of their railway.

Now, my Lord, will you go into the calculation in cross examination, or procure Mr. Chadwick to do it, giving him as a consideration a *carte blanche* as to the drains of the establishment and the disposal of the debris?

That done, my Lord, will you go into the calculation of the physical and mental results to the indwellers? I must dwell a short time longer on them. Meanwhile, will you hint to Lord John Russell to forego the window-tax in such buildings as these?

It is very important that this question should be carefully examined; for the working people, thoroughly alive to the evils of their existing rent-charges, are in complete ignorance as how best to remedy them. There never was any more mischievous fallacy for their interest than the Building Societies, as applied to workmen indiscriminately. By dint of weekly payments a man becomes in time the owner of a costly, badly constructed house—costly as compared with its value; and he is compelled to reside in one spot, whether his work may happen to be near or distant, and he is altogether precluded from removing to any other locality, unless he can sell or let his house, which would com-

monly be at a disadvantage. There can be no surer method of making working men dependent than by making themselves the owners of small fixed properties, whether in a house or a patch of land. Thus they preclude themselves from taking advantage of favourable changes in new localities. Of course, particular workmen, identified with particular establishments, are less subject to these considerations. They can calculate chances equally with their employers.

The advantages that would accrue to a body of workpeople, living in such a domicile as I have described, can scarcely be overrated. Supposing them well-paid workmen with abundant means for decent clothing and healthy food, after paying their rent, they would really be better off than many of those that are called the middle classes. It is difficult to define what is meant by middle class, unless we include all those who work with their heads and not with their hands, and the upper class as those who do no work at all. Many of these middle classes live in miserable houses, badly warmed, drained, lighted, and ventilated, and work hard themselves at domestic economising, or keep a "Marchioness" as a kind of white slave. But in our proposed dwelling a nobleman might live on an emergency without having his tastes offended, and certainly with more comfort than in many of our officers' barracks. There would be privacy or society at pleasure, as they might be solitarily or gregariously disposed. There would be warmth, and every means of obtaining well-cooked food. Baths at pleasure, warm or cold. A coffee-room with newspapers; a library with books; covered galleries to walk in in bad weather, and access at all hours by day or night. There would be absolutely no drudgery whatever for the women, no wet clothes to be drying at their husband's return, no water to carry up stairs, and no quarrelling at a common pump to obtain it, no descent with ashes or slops, no anxiety about their children when going out. If it be objected that quarrels would ensue by means of the large number of lodgers, the answer is simple. Consider the galleries as streets. Let any one imagine the ease of mind it must be to a father and mother to have an infant-school and children's school under the same roof, and at an expense almost nominal, and a library of books for their growing-up boys and girls, together with the influence of general good habits all around them.

Beyond this, so huge a body would have it in their power to command the services of the most efficient lecturers in every branch of art or science they might choose. Teachers for the schools, cooks for the kitchen, engineers for the water, baths, gas, warming, &c., and gardeners for the greenhouse, washerwomen, librarians, writers—and all would probably be found amongst the inmates, each one finding out his or her several aptitudes. Concerts would infallibly spring up, and dances follow. There seems no reason why religious teachers also should not attend.

There is another point of essential importance also. The establishment could maintain its own physician. The importance of this can scarcely be overrated. The whole time of a skilful man could be given to a body of people whose constitutions he would study as a gardener does his plants, and to whom he could continually suggest improvements in habits and customs. A far better salary could be paid to a man of high attainments by a regular body than is paid by those who get up lectures on speculation. They would probably be best paid on the sound principle developed by the Tartar dynasty of China, payment lessening as disease increases. And such an arrangement would in other ways be economic to the public. Hospitals and asylums would be less in demand in proportion as such establishments, increased. In case of illness in individuals, abundant nursing help would be found without expense, in distress. It is the existing inefficiency of the present mode of housing that imperatively demands hospitals, and asylums, and lying-in establishments.

If the economical advantages be such as are pointed out, and it will be difficult to show any fallacy, the probability is that such buildings would increase. The middle classes would certainly imitate them, and so would many of the upper classes, who in their clubs show rather what they desire than what they attain. With such modes of living, universal education would come about almost naturally, and with little need of government exertion.

To this mode of living the middle classes will be forced by a change now gradually taking place in the circumstances of society. I allude to domestic service. Every one exclaims "how bad the servants are becoming!" This is not the fact. The servants, as human beings, are really rising in the scale of creation, and find drudgery irksome, having an instinctive perception that drudgery is not really essential. Domestic service is irksome even with kind employers. Grown people do not like to have to ask leave to go out, having hired out their whole time, night and day. They also have their desire for domestic and family conversation, and by our present arrangements this cannot be managed. A family does not

employ another whole family. But were many families conjoined under one roof, they might employ other families. Domestic servants will grow less and less disposed to enter the house of the stranger, and abandon brother and sisterhood, as time runs on, and the abode of the workman becomes the home of comfort; and this will universally urge on mechanical and chemical improvement in every branch of domestic life, so that it will only be essential to have a servant for two or three hours per day, instead of being utterly dependent on you. Already they begin to insist on "sky-blue coats and scarlet breeches being considered in their wages." The philosophy of the matter is, that all human beings have their tendencies and aptitudes to serve one another in different modes, but the service can only be cheerfully performed when it is not mixed up with a quantity of distasteful drudgery.

Who shall try first this great experiment, my Lord? Shall it be yourself, a hereditary aristocrat, or an iron king of Wales, where slate and iron exist together? or a cotton lord of Manchester? or some separate oligarchy of the Great Railway Confederation? or shall it be some squatting Jonathan from the "far west," taking note of the "labour privileges" of Ireland on his journey from Galway to Dublin, now the new "highway to America," and thinking how it will do to bring his own cotton to his own mill on the sources of the Shannon, and there work it up by the "Almighty splendid fingers of that crowdy raising of Celtic girls?" Rouse yourself, my Lord. Do not suffer that ambitious "model republic" to go ahead in everything. Keep your pride of place. Lord Teignmouth teaches in the Ragged Schools. Set you up your school amid the well-clad working classes—to be better housed and taught by the result of your skill and energy.

I am, my Lord,
With much inclination to respect you,
COSMOS.

BARON VON RATHEN'S COMPRESSED-AIR LOCOMOTIVE.

Sir,—You were, some time since, good enough to admit some observations of mine on compressed-air locomotion, and in particular upon Baron von Rathen's system, of which you made some further mention in your Number for June 12, 1847. It may, therefore, interest your readers to know that the experimental compressed-air carriage for common roads there referred to is now completed, and that many of the points upon which I ventured to form an opinion have been determined by experiment. The reservoir of this carriage has a capacity of 75 cubic feet, and I have seen it charged with air of 50 and 60 atmospheric pressures by a six-horse power engine without any straining or manifestation of heat, and it has remained charged up to 25 or 30 atmospheres for two or three days without any perceptible leakage. I have seen the air thus compressed to 30 and 40 atmospheres admitted by means of the moderator at a constant pressure into the cylinders, and there worked expansively. When used at two atmospheres, *i. e.*, with an effective force of 15 lbs. on the square inch, it caused the wheels (the carriage being propped up) to make 60 revolutions in a minute; when used at three atmospheres the wheels made 120 revolutions. The refrigeration of the air when expanding from the reservoir into the moderator was also materially lessened by the means before mentioned, although the carriage was stationary.

Indeed, these facts may now be considered as proved, viz.: That air may be compressed to almost any extent, without deleterious heating or straining of machinery. That it may be retained in such a state of compression without danger from rupture or leakage for a considerable time, and that it may then be used at a constant pressure (which may be varied at will) without loss from refrigeration.

Other problems necessary to be resolved, and the details of experiments, cannot, of course, be entered upon until the carriage has made some successful attempts at self-motion, which it is expected to do very shortly. I shall then, perhaps, with your permission, trouble you with some further remarks. The present carriage is not, I believe, considered by any means a specimen of a common-road locomotive, but merely as practically illustrative of the feasibility of compressed-air locomotion. I am told, indeed, that it is not the Baron von Rathen's intention ultimately to drive by reciprocating cylinder engines at all, but by a rotary engine of his own invention; which I find is also, as well as the carriage at present being constructed at the College for Civil Engineers, Putney.

I am, Sir, yours, &c.,
x^2.

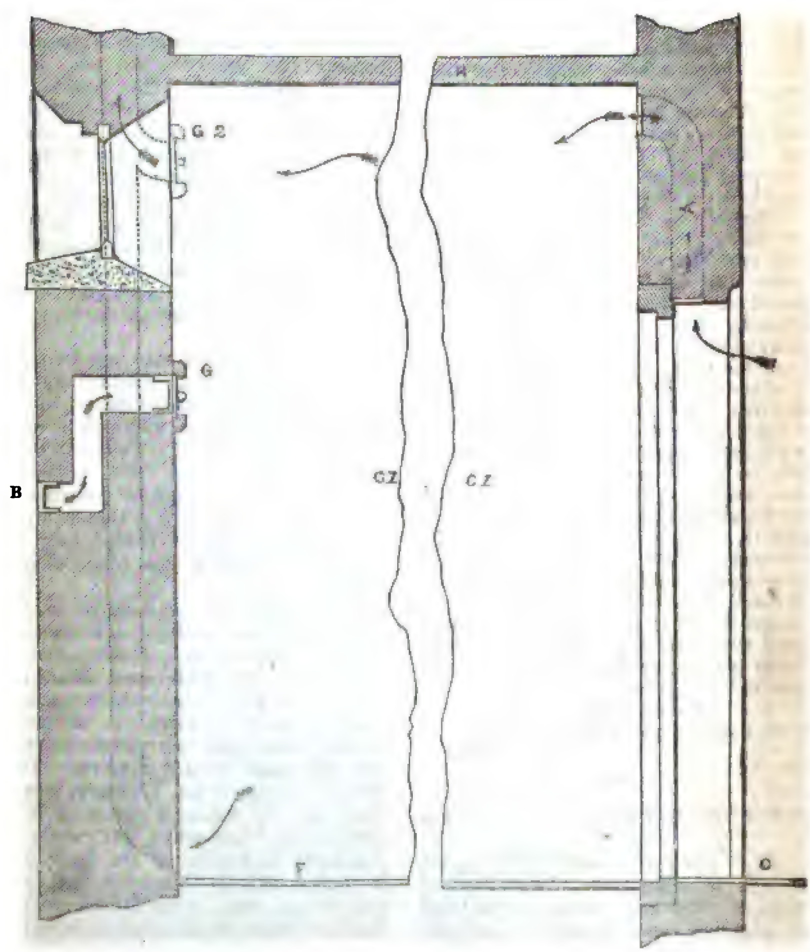
DESCRIPTION OF THE SYSTEM OF VENTILATION AND WARMING ADOPTED AT THE MODEL PRISON, PENTONVILLE.

(Concluded from p. 30.)

Warming.

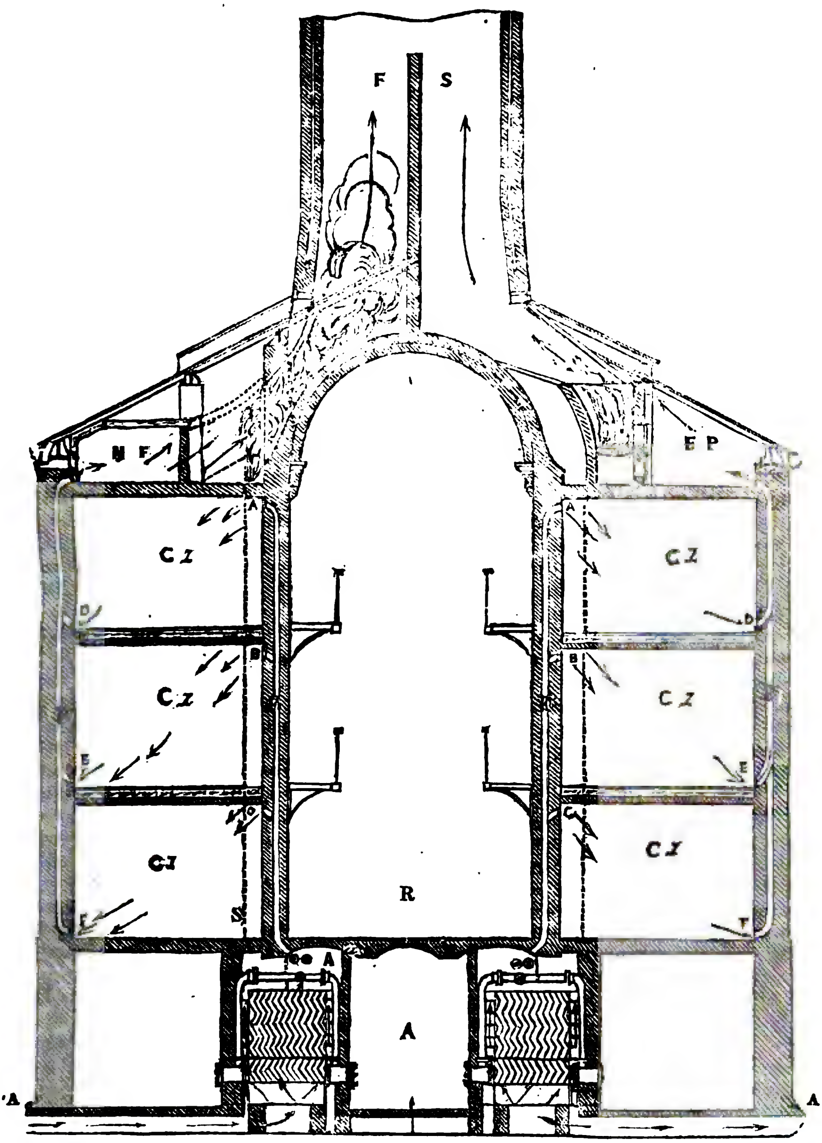
The system of warming adopted at Pentonville is that of the circulation of water in iron pipes, with which the public are already familiar. In a former Report the Surveyor-General explained the details of a regulator so contrived as to allow a prisoner to admit warm air from the main flue or cold air from the corridor, and recommended its general adoption in all new prisons. "By maintaining a degree of heat in the main flues, calculated to produce the maximum effect required, a prisoner would then have the power of keeping his cell at any temperature between that limit and the temperature of the corridor, which can be so regulated as to produce a minimum effect. About 5° or 6° will be found a sufficient range to embrace all the special cases which have been referred to; and it is only in such cases that any alteration in the original adjustment will be found necessary, during the day." On this subject the present Report contains the following additional remarks:

Fig. 8.



There appears reason to doubt whether an equally high temperature during the night is either essential or advantageous. This, however, is purely a medical question; but there is no difficulty in providing the means of lowering the temperature generally, and in a very short space of time, should it be considered conducive to health.

Fig. 1.



One mode of effecting it would be by freely introducing cold fresh air into the corridors, and "*shutting off*" the warm air from the main flues by the regulator, which should be in such case fixed by the officers at locking-up time, so as not to be at the control of a prisoner.

The same object might be effected by

admitting cold fresh air in several places into the main flues, at the same time drawing off the hot water from the pipes, and filling them with cold water.

The former plan would be the most economical in fuel, as the heat would accumulate during the night in the main flues, ready to be applied in the morning. The only inconvenience would be, that the officers on duty might feel it cold.

If the temperature be lowered by the second plan of admitting fresh air into the main flues, any loss of heat during the night would require to be made up by an increased quantity of fuel in the morning.

On these grounds, and also that the former plan would act more immediately and more certainly, I am disposed to recommend that regulators be brought into general use.

Openings into the main flues will still, however, be of advantage in lessening the friction, and thus increasing the facility of ventilating during the summer.

I explained in my former Report that, as a means of admitting air into a cell directly from the exterior, a square of the window might be glazed, so as to leave an opening without affording facilities for communication between adjoining cells. For prisons already built this will be a convenient method; but in new prisons it would be preferable to construct a small flue in the external wall,* as shown in fig. 8. (see ante, p. 62.)

Additional means for ventilating a cell during the summer months may be obtained by fixing a second grating in the foul-air flue near to the ceiling. A wooden frame and slide should be fixed over this grating, so that it may be used or not, according to circumstances. (See fig. 8.)

Fig. 1 (omitted in our last) is a sectional elevation of the building. A is the chamber for the warming apparatus; A^1, cold-air flue; B, the corridor; C^1, the cells; F F, foul-air flues; M F, main foul-air flue; S, smoke flue; F S, foul-air shaft; T F, shows where to the left hand is placed a fire-place for summer ventilation.

THE GRESHAM PROFESSORSHIPS.

Second Notice.

Amongst the endowments for the purposes of education, how very few can be quoted where the original intentions of the founder have not been perverted! It would, however, be difficult to find a parallel to Gresham College.

Sir Thomas Gresham had received a *liberal education.* Unlike the great mass of our modern "merchants," he had gone through the curriculum of the University of Cambridge. This, too, was in an age when young men repaired to the University with a desire to learn, instead of (as is too often the case now) to "while away" in frivolity and dissipation, the years of life for which, according to modern usage, no employment can be found. He had acquired a real knowledge of the learning of his time; and feeling the importance of that learning, he with princely magnificence made provision for its coming within the reach of the London citizen. Men highly distinguished in literature and science were amongst its earlier professors; and the college became, in fact, the great focus of all metropolitan learning.

Subsequently, however, to the close of the sixteenth century, it has for all scientific and literary purposes vanished from the face of the earth! Were another Ward to write a History of the College and the Lives of its Professors, how many pages could be added to that which the first Ward wrote more than a century ago? He may, indeed, by consulting the dusty archives of the Mercers' Company be able possibly to fill half a page or so with entries respecting appointments to the several Professorships; and probably too, he might be able to find some autograph signatures of those fortunate personages, on the receipt of their salaries. But how many, on the other hand, could we find in that list, whose names are inscribed on England's roll of learned men? Viewed, therefore, even as a sinecure appendage to the income of the laborious man of intellect, this trust has been grossly abused; but how much more abused in its having been left unproductive of the exalting benefits which its founder intended to confer on his fellow citizens!

The attempt to comply *literally* with the instructions contained in the founder's will was probably one of the causes of the decline of this College. Our Universities, though slow enough to be moved by the influence of circumstances, have been *compelled* so far to forego the literal adherence to the mere terms of their charters, as the increasing intelligence and increasing requirements of the country rendered necessary. The Gresham alone has stood still—or rather, has

* Flues of this description have been made in the military prisons built within the last few years.

retrograded: for whilst it has adopted none of the improvements which have resulted from subsequent experience in tuition, it does not even fulfil to the letter the prescribed rules laid down for its government. If, therefore, its trustees fall back upon the literal construction of the will, let them be judged even by that, and they will be found wanting. Their authority, therefore, lapses to the Crown which gave the charter; and it rests with the Crown to modify it so as to become consonant to the wants of the times. They cannot escape from this dilemma: but, except it were taken up by the Government itself, it would involve a chancery suit, which might end in the absorption of the entire property by the lawyers. This, however, would be cutting off Gresham's head to cure Gresham's head-ache.

A parliamentary commission, or a royal commission, or any system of inquiry into the management of this College is impossible, whilst the Premier represents the Corporation of London in the House of Commons. If even the Sanatary Commission cannot penetrate within the city boundaries, when the health of our Great Babylon is at stake, it would be preposterous to hope that so unimportant a thing as a Knowledge Commission should dare to invade that sacred territory. Were any unlucky Commissioners so rash, they would (in a metaphorical sense at least,) be captured by the Lord Mayor's officers, put into the pillory and pelted by the "London Prentices," and finally deposited in the strong-house in St. George's Fields, which stands as the modernised representative of the antique Bedlam.

We speak of the present: but "the good days are coming." Corporate influence will not prevail even to save the city of London from a searching investigation into the dispensation of its trusts, and a sweeping reform of its thousand abuses. Nor is the time so remote as the city-conservatives may imagine, even though the meanest devices in which the most doubtful traders are such adepts, should be (as we fear they will be) adopted for the defence of their time-dishonoured system. Whatever may be the opinion of the citizen, it is the opinion of the honest Englishman, that, *a trust is not a mere perquisite.* If, however, the Gresham trustees are not so intoxicated with their "perquisites," as to fondly imagine them perpetual, we trust they will make some attempt to ward off public denunciation by reforms emanating from amongst themselves. Where would our two ancient Universities have been now, had their "caputs" indulged in the same fancied immunity from public opinion? We anticipate the answer. "That the Universities and the Gresham Trustees have *alike consulted their interests* in the different steps they have taken: it being the interest of the Universities to get as many men as possible on the 'boards,' since education is the trade of those places; and it being the interest of the Gresham Trustees to keep possession of the funds of the endowment in aid of that great principle of London corporation, conviviality, and influence."

Whatever truth there may be in the former part of this opinion, the latter part is certainly an error. It is an opinion founded on very short-sighted policy, even viewed as *interested* policy; but merchants are more conversant with the values of stocks and mercantile wares, than they are with *man as a social and intellectual creature.* Had any one of Gresham's trustees been gifted with Gresham's prescience, he would have foreseen the infinite advantage of keeping up and extending the influence and usefulness of this College, even as regards its *pecuniary results.* This College might have been the focus, the great leading exemplar of a London University—far more efficient than the "concern" which now bears that name, can ever by any possibility become.

But its chance is not even yet wholly past. It may regain the position it has well-nigh thrown away; and may, with prudence and foresight, still take the metropolitan position that would have delighted the merchant prince, and have secured the approbation of even his jealous queen. The Gresham College may yet, if its trustees only exercise the prudence in their official positions which they do in their own counting houses, become the powerful leader of metropolitan intellect and learning, and in an eminent degree the representative of England in all that relates to the development of science and literature. It may become the real nucleus of English mind—the kernel of English knowledge.

"But *how?*" exclaims the corporationist, as he reads our pages over his choice glass of wine after his six o'clock dinner. Well, read on, and you shall know, good conservative friend!

The recent efforts to establish colleges in London have arisen from a strong feeling of their *necessity;* and they have arisen amongst men, too, of your own class, who happened to be a few degrees farther on the road towards enlightenment than yourselves. They knew that it was useless in the first place to seek *your co-operation;* they knew also that it was useless to plead with your and their own class, if pecuniary advantages were left out of the question; and they knew, still further, that without the aid of some talkative members of Parliament who could be identified with their movements, it would be impossible for their colleges to gain any standing in public estimation. They took their measures accordingly, like shrewd men of the world—organized a body, put a heap of hewn stone in Gower-street, and called it the "London University." *Still* YOU *moved not,* beyond putting together a corresponding heap of stones in Coleman-street, after the destruction of your Royal Exchange. The Church, however, took the alarm; and she built up another heap (not of stones, but of bricks with stone faces) as an eastern buttress to Somerset House, and called the thing "King's College, London."

This did not—does not alarm you. Nevertheless, you might even now reform your abuses, and by a proper employment of your powers and your funds, render Gresham College more dignified and more useful, too, than either of these new colleges, combined with all the joint-stock schools which are connected with them under the name of London University. You have antiquity, *préstige,* and ample funds in your favour; all of which are essential elements in an Englishman's notions of social and corporate greatness. If you could only bring yourselves to act in a large and liberal spirit, all the others would be glad to shelter themselves under your wing, and Gresham College would again become what Gresham College has been—the centre of the intellect of the metropolis. It will, soon, however, be too late to regain your position; and then, only think how the reforming spirit of the age may deal with your "precious perquisites!"

But science and literature *you* consider to be "no business of yours;" whilst *we* consider that the custody of the College renders it your business both in law and in honour. If science be not your business, why do you accept its trust and appropriate its funds? We admit that you know little of its value, except in connection with the money you divert from its cultivation and diffusion; but if learning be really only useless trifling in your honest belief, why do you not legalize your system of spoliation by an act of Parliament to protect you? Let the Corporation of London (if it dares to avow its principle of action) at once proclaim, by an application to Parliament through its representative-premier, that money left for the cultivation of letters is more patriotically expended when spent upon ripe venison and green turtle. The affirmative of the question would, no doubt, obtain a greater number of suffrages in the House than Mr. Hume's proposition for electoral reform was so fortunate as to obtain! Do not, at any rate, hold up your toy-building in Gresham-street, and its "wall-lectures," as a fulfilment of your trust; for you only add insult to insincerity, in pretending to think the public can feel otherwise than disgusted with such an argument.

But we must proceed to consider the particulars involved in a reform of the management of Gresham College.

The manner of teaching by *lecture* was the universal practice, as regarded everything beyond mere rudimental learning, during the middle ages, and down to a much later period than that of Sir Thomas Gresham. The professorial system has, however, been so greatly modified in our own universities and public institutions, that it can hardly be said now to form any marked feature in our educational system. In earlier times none attended a university who did not go there to study—to learn—and to learn in the best way they could. Books were scarce and costly in Gresham's time; and few even of those were written by men who were fully masters of their respective subjects. No means then existed but *oral prælections* for the general communication of knowledge; and to effect this was the business and the duty of the professor. As good books on the several sciences (especially their elements) began to appear, the professional system began to decline: for

young men found it was easier to gain their knowledge from their books deliberately, than to trust to their seizing the reasonings of the professor in all their force. Hence the professor was obliged to sink himself partly into the *tutor*. In both our universities, too, the main business of the college tutor is to stand *in loco parentis* to the under-graduate—to expound in a general and sketchy way the subjects which it is requisite for his pupils to read—and to examine them at stated times (*once a term*) as to the proficiency they have made. He gives, however no explanation of the difficulties which the student may encounter; but merely tells him *what books to read*, and leaves him to comprehend them as he can. Left thus to himself, the under-graduate has been compelled to seek assistance from others more advanced than himself in understanding his books; and this has given rise to a large and most useful body of men resident in both universities, known by the name of *private tutors*. It is by them in reality that the educational business of the universities is carried on; and without their aid, the numbers on the boards would be annually decimated, till at last the college halls would form as desolate an exhibition as the Gresham lecture-room. The *endowed professorships*, however, are still kept up in both universities, although with what of public benefit no one has ever been able to tell us. Attendance on them is not compulsory; except, indeed, that the bishops have now adopted as a "compulsory" rule the production of a certificate from the Professors of Divinity in both, that the candidate for holy orders has attended his lectures during *one term* "voluntarily." Nothing is to be gained by attending them; and hence generally they are unattended. Occasionally, indeed, when the chairs are filled by able men (which is not always the case, even in the universities) men whose educational course is finished, and who have taken their degrees, may be found to attend the professorial lectures. This, we conceive, constitutes their great recommendation; as it affords to the professor a most important opportunity for generalising and systematising the crude mass of knowledge which the under-graduate had heaped together in order to take his B.A. degree—for "a crude mass" must the knowledge of every man, reading his subject for the first time, always be. The professor who makes it his business to methodize these masses into consistent forms—to point out the relations and bearings of the different parts of this mass—to dwell upon the history of discoveries in the science, especially pointing out what yet remains to be done in it—to explain the subtle philosophy which runs through and cements together all its parts—to show the applications that have been made of science to the comfort and happiness of civilised man, viewed both mentally and materially:—such a professor would be the benefactor of his age; for this is the class of instruction at once the most difficult and the most rare, though unhappily it appears to be in our day the least valued class of all.

It is upon this ground, then, that we would earnestly implore the Gresham College to take its stand. No other institution in London has the means to do so, but the Gresham; and the trustees consenting to make this cosmopolitan use of their powers, they would perform a part so graceful and so patriotic as to earn for themselves the gratitude of the literary and scientific world. How many hundreds of young professional men there are in the metropolis at the present moment, who would hail with delight such an appropriation of the Gresham funds!

Our view then is, that the Gresham lectures should be professorial lectures still—not tutorial lectures. So far, then, we advocate nothing beyond a selection of proper men, who would rather look to the public benefits they could render and to the reputation attached to their office, than to the mere emoluments that might accrue from their appointments.

The *time*, too, of delivering these lectures is so absurdly chosen in relation to our social habits, as to render them utterly useless to almost every man who is likely to be interested in them. On the first institution of the college, the Latin lectures were delivered at nine and two, and the English at ten and three; but now the morning lectures are three hours later, and the evening five: the very hours when, as regards the morning, in our days, the merchant must be upon 'change, and the professional man in his duties, and the most advanced student in his school; and just having dinner in the evening. All society-meetings are held in the evening in our time; as that is, generally speaking, the

only time that an Englishman, and a Londoner especially, can fairly have at his disposal. Those society-meetings, too, are well attended by those who take interest in them, in all cases where the proceedings have not sunk (as in some of the older routine-ones) into a mere formality, like the Gresham lectures. Abolish, then, the morning lecture, and give increased encouragement to the evening one.

The custom of delivering the lecture first in Latin, and immediately after in English, will surely be admitted by the trustees themselves to be a piece of gratuitous absurdity, and calculated only to throw an air of ridicule over the stately process. If, in accordance with the terms of the founder's bequest, the lecture must be read in Latin, it must be remembered that Latin was in his time the universal language of the learned world; and this having almost as universally ceased to be the case, it would be perfectly consonant with the intentions of the founder, if the mere title of the lecture were given in Latin.

It is the common understanding in all the societies (the Royal, for instance, which is so nearly akin to the Gresham in its original, and in some important parts of their subsequent histories) to call a paper "read" when its title has been read to the meeting. The public would not complain of the change; and were some captious objections even made to it, could not her Majesty in Council so far modify the charter of the college as to legalise the change? Possibly, however, some of the sapient trustees* may have heretofore imagined that imperfect information delivered in barbarous Latin, "is more learned" than sounder information delivered in our own vernacular tongue. It would be but in keeping with what they think now, when they wonder over a common-place fragment of some Roman author, which is now and then slipped into a leader in the *Times*, to give a zest to the imagination of the un-latinized reader, or to complete with the first words that present themselves to the writer's mind, a phrase that he had not time "to round off into good English." Let, however, this absurdity be eliminated from the Gresham lectures.

We have already said that we would have these lectures *supplementary* to every university, hospital or college course of academic and professional studies. This would interfere with the objects and interests of no other institution: but it would be useful to the members, the professors, lecturers, and teachers in all of them. An improved and consistent mode of general scientific teaching might be educed from the professors of the Gresham; and we are convinced, as we said last week, that this College would "gain an English, and ultimately a European, reputation," if only it were managed in conformity with the "living spirit" rather than the "dead letter" of the Founder's bequest. Will no motive other than gold, and what gold can purchase, inspire the enthusiasm of the masses of "London clay" that regulate the city destinies? We hope that they are capable of a higher and purer ambition than the world gives them credit for: and we would at least *hope*—we would gladly say, could we do so, *believe*—that having an opportunity so favourable for refuting popular opinion, they will give an unquestionable proof that they possess higher qualities than those of the miser and the swine!

We shall continue to watch the progress of this "election;" and we believe that we possess the means of watching it effectually. We shall be most glad if we

* In order that the members of the Gresham Committee might not plead ignorance of our strictures, we applied to the Mercers' Company for a list, in order to send them copies, *but it was refused*. We have, nevertheless, procured one, which we believe to be correct, and have given their respective trades, &c., as they have chosen to designate themselves in the "Directory." A walk past their residences will show with what propriety (according to its *English sense*, at least) the term "merchant" is in some cases applied:

Rt. Hon. the Lord Mayor (Alderman Hooper.)
Sir Peter Laurie, Knt., Park-square, Regent's-park.
Sir George Carroll, Knt., 34, Cavendish-square.

COMMONERS.

Mr. J. T. Morris, 138, Aldersgate-street, Stationer and Printer.
Mr. James Lake, 33, Aldgate, Woollen Draper.
Mr. William Lister, 78, Basinghall-street, Factor.
Mr. B. Bower, 106, Lower Thames-street, Orange Merchant.
Mr. W. A. Peacock, 161, Bishopsgate-street Without, Baker.
Mr. W. Stephens, 78, Bishopsgate-street Within, Brandy Merchant.
Mr. T. Dakin, 73, King William-street, City, Chemist and Druggist.
Mr. James Hoppe, 5, Bennett's Hill (business not given.)
Mr. R. L. Jones, 40, Little Moorfields (business not given.)

These are the men who are privileged to decide upon the *fitness of a Professor of Geometry* in Gresham College! Is any comment necessary?

can report favourably of the exercise of the "elective franchise;" and shall gladly withdraw our censures for the past, if the trustees only show some sense of decency in their choice of the new professor. We care not who he is, so that he be the best man that can be found to come forward—a man in whom the scientific world can place implicit confidence; and, at the same time, a man who will pledge himself to carry out in their true spirit the noble designs of the merchant prince of England. Such a man may *shame* his colleagues into a sense of their duties, or teach them the grand virtue of RESIGNATION. Let all the professors be made to feel themselves *as before the world*, and they will either do their duty and gain honours for themselves, or they will give way to others more ardent, more learned, and more high-minded than themselves.

Above all things, let *perpetuity*, and its consequent negligence of duty, be stopped at once and for ever in respect of these appointments. Let each Gresham professorship be looked to as a golden opportunity which occurs but once in a life, for the most gifted of men to leave a permanent mark of his existence and of his power of influencing for good, the onward course of the intellectual human race! Let him be taught to concentrate his whole force upon a high and honourable effort for immortal honour from his species; and that such an opportunity if once thrown away, can never come to *him* again! Then, and only then, will the Gresham become worthy of Gresham and of London!

ELECTRICAL MACHINES.

Sir,—In answer to an inquiry in your last Magazine of "M. G. W. Laurence," concerning the best method of making the cushions for the new plate electrical machine of my invention, mentioned in your last vol., p. 515; I beg to say, the materials I used were these: I procured some good horse hair and had it well dried, I then enclosed it in a casing of silk similar in shape to those used in other plate machines. This I decidedly prefer to dried flannel, as suggested by Mr. "L." Both methods I have tried, and the former I must say is far superior to the latter.

If it is the intention of Mr. "L." to construct an electrical machine on my principle, I shall be very happy at any time to give him any information on the subject he may require. Yours respectfully, J. B.

Manchester, July 5, 1848.

AGRICULTURAL IMPLEMENTS. — ROYAL AGRICULTURAL SOCIETY'S EXHIBITION AT YORK.

We extract from the *Times* the following account of the prizes and medals awarded for agricultural implements at this week's York Meeting of the Royal Agricultural Society. The great number of portable steam-engines brought forward is remarkable; and is no doubt to be accounted for by the near vicinage of the great manufacturing towns of Leeds, Sheffield, Birmingham, &c. At the Newcastle Exhibition there were only three exhibited; at the Northampton but one. On the present occasion the number exhibited was no less than seventeen. The prize for the best, it will be seen, was awarded to Mr. Hornsby, of Lincoln.

PRIZES.

For the best plough for heavy land, 10*l*., the 1st of 33—Mr. Busby.

For the best plough for light land, 10*l*., and 2d of 30—Messrs. Howard and Son.

For the best drill for general purposes, 15*l*., the 1st of 17—Mr. Hornsby.

For the best turnip-drill on the flat, 10*l*., the 6th of 37—Mr. Garrett.

For the best turnip-drill on the ridge, 10*l*., the 4th of 17—Mr. Hornsby.

For the best scarifier or grubber, 10*l*., the 1st of 18—Messrs. Sharman and Co.

For the best machine for making draining tiles or pipes, 20*l*., the 1st of 5—Mr. Whitehead.

For the best harrow, 5*l*., the 16th of 30—Messrs. Howard and Son.

For the best steaming apparatus, 10*l*., the 16th of 18—Messrs. Sharman and Co.

For the best skim or paring plough, 5*l*., the 6th of 6—Mr. Kilby.

For the best horse seed-dibbler, 10*l*., the 1st of 4—Mr. Newberry.

For the best one-horse cart, 5*l*., the 1st of 4—Mr. Eaton.

For the best waggon, 10*l*., the 35th of 71—Mr. Stratton.

For the best thrashing machine, 20*l*.

For the best steam-engine, 50*l*., the 7th of 17—Mr. Hornsby.

For the best corn-dressing machine—10*l*.

For the best gorse-bruiser, 5*l*., the 13th of 38—Messrs. Barrett, Exall, and Co.

For the best implement for distributing pulverized manure, 10*l*., the 6th of 17—Mr. Hornsby.

For the best grate or stove for cottages, 5*l*., the 21st of 32—Mr. W. N. Nicholson.

MEDALS.

Norwegian harrow, the 82nd of 91—Mr. Croskill.

Hay-making machine, the 1st of 18—Mr. Smith, of Stamford.

Horse-rake, the 14th of 14—Mr. Hensman.

Horse-hoe on the flat, the 11th of 37—Mr. Garrett.

Horse-hoe on the ridge, the 7th of 33—Mr. Busby.

Grass-land cultivator, the 21st of 33—Mr. Busby.

Linseed and corn-crusher, the 15th of 18—Messrs. Sharman and Co.

Liquid manure drill, the 2nd of 2—Mr. T. Chandler.

Chaff-cutter, the 5th of 10—Mr. Cornes.
Cake-breaker, the 4th of 32—Mr. W. N. Nicholson.
Root-washer, the 61st of 91—Mr. Croskill.
Cesspool and tank-cleanser, the 4th of 12—Messrs. Dean, Dray, and Co.
Cheese-press, the 8th of 11—Mr. Bruckshaw.
Shock remover, the 2nd of 5—Mr. Summers.
Level—Mr. Blundell.
For improvements in the transparent water gauge, as attached to the steam engine—Mr. Hope.
Steaming apparatus, 6th of 10—Mr. R. Robinson, Belfast.

The 12 sheds of the implement yard are divided into 158 stands, each exhibitor having one for himself, and having his instruments numbered and ticketed therein. Some of the stands have only one article exhibited in each, while others have as many as from 30 to 90. There are 16 machinists who have each contributed from 30 to 90 articles, but of that number only seven have been successful enough to obtain prizes, so that from this fact the inference may be fairly drawn that the judges have paid more attention to the quality than to the quantity of implements exhibited. Of the 21 prizes and 17 medals awarded, 4 have been given to Mr. Hornsby, 3 to Mr. Busby, 2 to Messrs. Howard and Son, 2 to Mr. Crosskell, 2 to Mr. Garrett, and 2 to Messrs. Sharman and Co. Mr. Hornsby, who exhibited only 17 articles, must be considered the most successful competitor of the show. The prizes won by him are all large ones, being awarded for important implements. The steam-engine to which a 50*l*. prize was given is thus described in the catalogue:

"A six-horse power portable steam-engine; invented, improved, and manufactured by the exhibitor. It is simple in its construction, fitted with governors, and easy to manage, with tubular boiler, fire-box, and smoke-box complete."

Mr. Busby's plough for heavy land "is capable of working 12 inches deep when required, and with a lighter mould-board will not be found too heavy to be used as a two-horse plough." Its price is 5*l*., and it has now the recommendation of being a second time successful, having won a similar prize at Northampton. Messrs. Howard's plough for light land is an improvement on their patent iron plough with two wheels, which has been successful at all the meetings of the society. The alteration introduced is a new method of fixing the wheels, by which the width of furrow may be altered more readily than upon the old plan; it is also superior for deep ploughing, and upon dirty land, where the soil accumulates on the old sliding axle.

Mr. Garrett's "turnip drill on the flat" is also an established favourite with the society, having won its prizes at Cambridge and Northampton; it is called

"A four-row lever drill, for the purpose of depositing turnips or mangel wurzel seeds with artificial or well-rotted farm-yard manure, for either flat or ridge-ploughed lands. It is made with improved levers and coulters, whereby the manure may be deeply buried in the land below the seed, and any quantity of soil placed between them. The seed coulters may be adjusted to drill the seeds either deeper or fleeter, as circumstances may require. This drill is also adapted for drilling beans, peas, and carrots, with manure, at any intervals apart."

The steaming apparatus of Messrs. Sharman and Co., the catalogue says—

"Is adapted for quickly generating steam to be applied to the purposes of cooking linseed, chaff, potatoes, and other food for cattle. It is made of copper and galvanized iron, and can be used without the aid of brickwork. A jet of steam is so introduced into the compound tub as to keep the food in agitation, and obviate the necessity of stirring it up in the ordinary way."

The machine for making tiling, drains, and pipes to which the prize was awarded is a new invention of Mr. John Whitehead, of Preston, Lancashire. It is very strong, and the box will contain 8,744 cubic inches of clay. It is thus described:—

"It may be easily turned the whole day by one man, who also may fill the box, while a boy cuts the tiles off and carries them away. The front of the box is large enough to receive a die-plate, with seven 1½-inch or five 2-inch tiles in width, and if placed one upon another, twelve 1½-inch or nine 2-inch tiles. Any description of tiles may be made by this machine. A wrought iron screen plate may be attached when tiles are not being made, for the purpose of extracting stones from the clay."

WEEKLY LIST OF NEW ENGLISH PATENTS.

Walter Orsell Palmer, of Southacre, near Swaffham, Norfolk, farmer, for improvements in machinery for threshing and dressing corn. July 10; six months.

Anthony Lorimier, of Bell's-buildings, Salisbury-square, City, bookbinder, for improvements in combining gutta percha and caoutchouc with other materials. July 10; six months.

Richard Roberts, of the Globe Works, Manchester, engineer, for certain improvements in and applicable to clocks and other time-keepers, in machinery or apparatus for winding clocks and hoisting weights, and for effecting telegraphic communications between distant clocks and places otherwise than by electro-magnetism. July 11; six months.

Leon Castelain, of Poulton-square, Middlesex, chemist, for improvements in the manufacture of soap. July 11; six months.

Felix Alexander Fessud de Beauregard, of Paris, engineer, for improvements in generating steam, and in the means of obtaining power from steam engines. July 11; six months.

Matthew Kirtley, of Derby, engineer, for improvements in the manufacture of railway wheels. July 11; six months.

Jesse Ross, of Leicester, agent, for improvements in apparatus for dibbling and other agricultural purposes; part of which improvements are applicable to propelling vessels. July 11; six months.

William Edwards Staite, of Lombard-street, City, gentleman, for improvements in the construction of galvanic batteries, in the formation of magnets, and in the application of electricity and magnetism for the purpose of lighting and signalizing, as also a mode or modes of employing the said galvanic batteries, or some of them, for the purpose of obtaining chemical products; parts of which improvements are a communication. July 12; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
July 5	1491	Charles Greenway.........	Park-street, Grosvenor-square...	Stock.
7	1492	Richard Restell...........	Croydon................................	Cylindrical brooch protector.
10	1493	George Frederick Morrell	Fleet-street	Flower and plant label.
11	1494	John Sparks	King-street, Tower Hill	Railway dispatch and cash box.
12	1495	William N. Nicholson ...	Newark-on-Trent	Newark cottage range.
„	1496	William Bullock Tibbits	Branston	Spring holdfast for window sashes.
„	1497	William Rawlings Sobey	Exeter	Spring lock for a brooch.
„	1498	Gilbert Dickinson........	New Bond-street.....................	Artists' vade mecum.

Advertisements.

NOTICES TO CORRESPONDENTS.

Our "Huddersfield" correspondent has been imposed upon; the half yearly Supplement, with Table Index, &c., was published gratis.

Mr. Dredge's paper on the Sea Wall Question is unavoidably postponed till next week.

Mr. Hailes' Orrery Globe.—*A pair of globes on this plan may now be seen at the Polytechnic Institution; they are very beautifully made, and explain Mr. Hailes' peculiar astronomical views, better than anything which he has yet printed on the subject.*

CONTENTS OF THIS NUMBER.

Mechanics' Magazine,

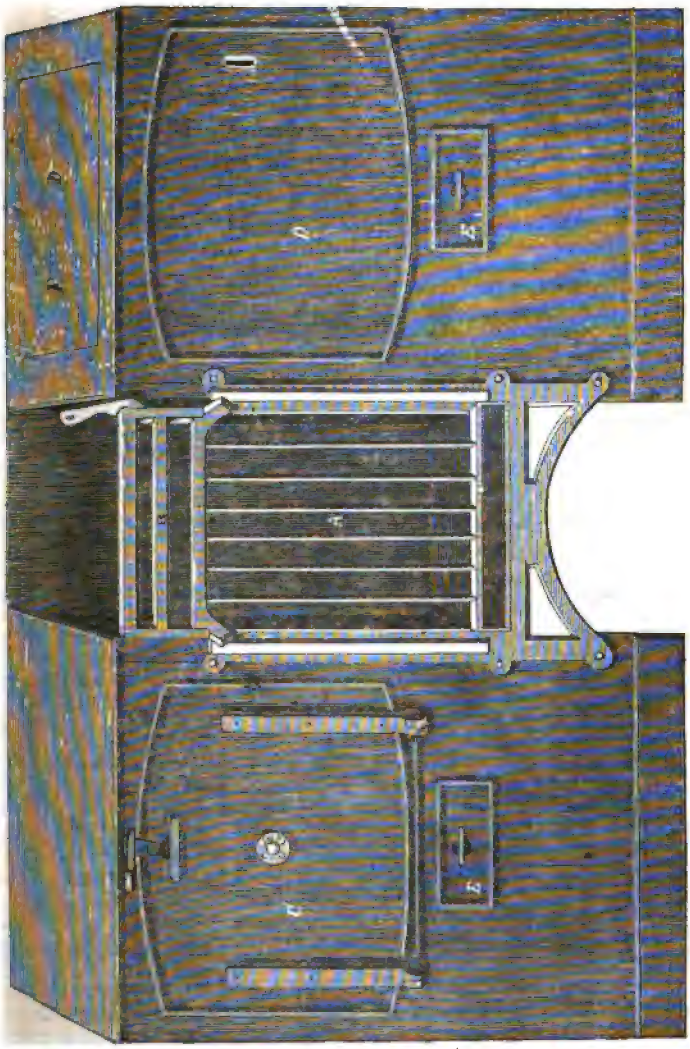
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1302.] SATURDAY JULY 22, 1848. [Price 3*d*., Stamped, 4*d*.

Edited by J. C. Robertson, 166, Fleet-street.

THE NEWARK COTTAGE RANGE.

Fig. 1.



THE NEWARK COTTAGE RANGE.

[Registered under the Act for the Protection of Articles of Utility. Mr. W. N. Nicholson, of Newark-on-Trent, Agricultural Implement Maker, Inventor.]

The "Newark Cottage Range," represented in the accompanying engravings, obtained the prize at the York Agricultural Meeting last week, as the best of thirty-two articles of this description then exhibited, and will be found on examination fully to justify the preference given to it.

Fig. 1 is a front view of it in perspective; and fig. 2 a cross-section of it through the centre of the fire place.

A is the fire range, which consists simply of a frontage of vertical bars, contained in a frame which slides up and down in grooves. The two sides of the interior of the fire-place are composed of cheeks of fire-clay, and the back, G, of a slab of the same material, which is of the peculiar angular form shown in fig. 2, and so inclined towards the bottom bar of the range as to render any bottom grate unnecessary. B is a fall bar which is swivelled so that it can either be let down over the fire-place or over the hearth, according to the degree of heat desired to be imparted to the pot, kettle, or other article placed upon it. A side-view of this bar and the parts connected with it is given in Fig. 3. C is the oven, the door of which forms a convenient hot shelf when turned down; D is the boiler; and F the boiler lid, which fits into a sunk joint so as to come perfectly flush with the rest of the top of the boiler.

Fig. 2.

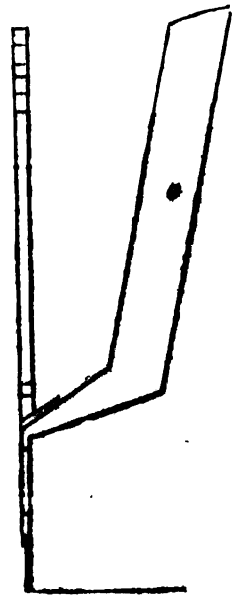
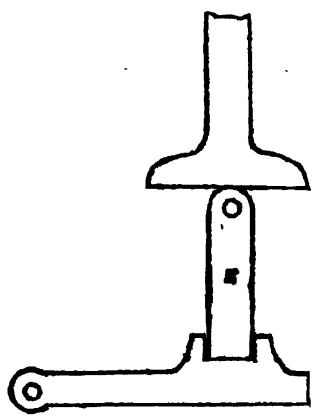


Fig. 3.



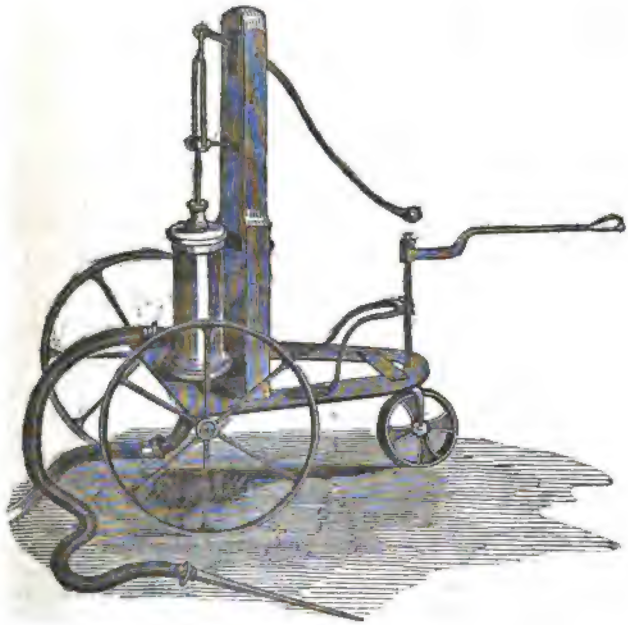
The smallness of the fire space in this apparatus, and the narrowing of it in the line of least utility, namely from back to front, are circumstances highly favourable to economy of combustion; while the fire-clay sides and back most effectually protect the adjacent oven and boiler from the direct action of the fire, and render them consequently much more durable than usual.

To free the fire-place from ashes, all that is necessary to be done, is to raise the front range a little, when the cinders will fall out by their own weight from off the inclined back, G; no raking whatever required. The flues also may be cleared through the doors, EE, without disturbing the fire.

The cost of this very simple and most efficient apparatus, is not much greater than that of the worst and commonest article of the grate and stove class. One with oven and boiler complete costs from 35s. to 40s.; with oven only and sham side, it may be had for 25s.

MESSRS. DEANE, DRAY, AND DEANE'S PORTABLE FIRE-ENGINE AND WATERING PUMP.

[Registered under the Act for the Protection of Articles of Utility.]



We here present our readers with another of the articles which had the good fortune to be honoured with a prize at the late York Agricultural Meeting. It was one of twelve machines exhibited, having for their common object the combination in one framework, and on one set of wheels, of an irrigating engine and a fire engine. The pump is of the same class as that described in a former number of this Magazine (vol. xlviii. p. 150,) having an air-vessel surrounding the barrel of the pump. By the exertion of a little force, two men are able to send a stream of water on to the top of a building of considerable height; and for watering purposes a single hand can command a circle of about 80 ft. diameter.

STEAM BOILER WATER GAUGE.

[Registered under the Act for the Protection of Articles of Utility. George Howe, of 199, Great Guildford-street, Southwark, Engineer, Proprietor.]

This is another very useful invention, which obtained an honorary medal at the late York Agricultural Meeting.* Fig. 1 is a sectional elevation of so much of this gauge as is necessary to show the peculiarity in its construction. A is one of the sockets into which one end of the glass tube, B, is fixed. C is the aperture of communication with the boiler, and D a nut for closing up the opening through which the tube is slipped into its place. E is a ring, of vulcanized caoutchouc, which is first passed over the end of the glass tube, after which the glass tube, with the ring upon it, is put through the socket, A, and drawn up until the ring rests against the shoulder, *a a*, of the socket. By this arrangement any leakage is entirely prevented, while, at the same time, it admits of the expan-

* In our last week's list, the name of the inventor was erroneously given as *Hope*, instead of *Howe*.

Fig. 1.

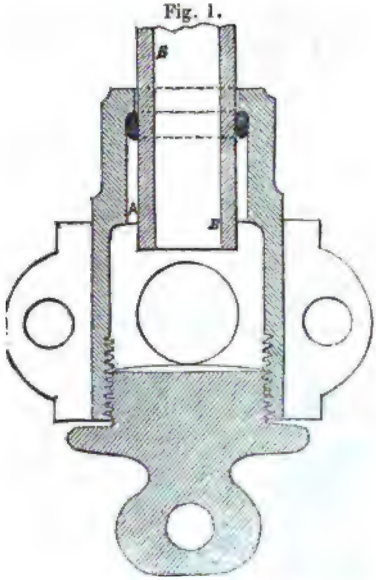
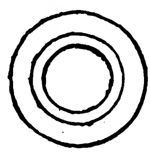


Fig. 2.



sion and contraction of the parts without endangering the glass.

A plan of the glass tube, B, and vulcanized ring, E (before being put into the socket) is given in fig. 2.

SEA-WALLS—SHOULD THEY BE SLOPING OR VERTICAL?

Sir,—The form of sea walls is a subject of considerable importance, particularly at this moment, when a large amount of public money is about to be expended in works of this description, in the construction of harbours of refuge. Now that the subject is broached in the pages of the *Mechanics' Magazine*, the antagonistic opinions which exist are likely to give rise to a great deal of discussion.

As I have only superficially glanced through the Report of the Dover Harbour Commissioners, I cannot with confidence refer to any of the evidence. My remarks will therefore be applied only to those papers that have lately appeared in your Journal.

There are two points to which we must particularly pay attention in considering the construction of sea walls:

First. The nature and the direction of the force of the waves acting against the wall; and

Secondly. The most effective form of the wall in resisting this force, which depends in a measure upon the nature of the material of which the wall is composed.

First, then, the agitation of the sea is caused by the horizontal force of the wind. The tempest in passing over the surface of the water at first produces a ripple—which increases until the waves rise to the height we daily witness.

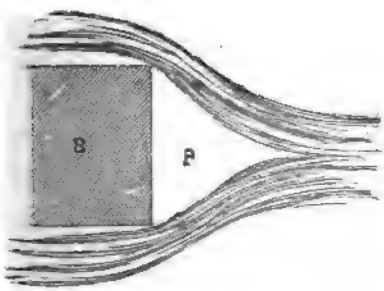
The wind acting in a horizontal direction produces (so to speak) a mechanical effect, which must be absorbed in urging the water in the direction in which it acts, and by the friction between the particles of water in the rise and depression of the waves. That the waves of the sea move in the direction of the wind is evident from the effect produced by it on the ebb and flow of the tide.

That the force of a wave arises from something more than its mere altitude is plain from the registrations of Mr. Stephenson's Marine Dynamometer, (see *ante* vol. xlviii., p. 436,) and from the fact of the great height to which spray is occasionally projected. I have seen the spray in the Bristol Channel thrown fifty feet above high water level.

The object of a sea wall in the construction of a harbour of refuge is to break the force of the waves; on one side of the wall the sea is raging with all the violence of a tempest, on the other side it is comparatively tranquil; the force of the waves is destroyed by the interposition of the wall, which must receive it. But is a vertical face best adapted for this purpose? Is it probable that this form has the power of suddenly checking the force of the waves and drawing a distinct line between the raging sea and a complete calm, without receiving any shock? And if the wall does receive a shock, is not the vertical form essentially weak to resist it? Of course, the arguments in favour of a vertical wall are founded upon the supposition of the action of the waves being only in a vertical direction; but what grounds are there for this opinion? All the arguments in support of it appear

to me extremely weak and hypothetical. Of what use would a floating breakwater be if the action of the waves were only vertical?

In my judgment Professor Airey attaches too much importance, to the bare fact of his rising and falling on the surface of the waves, in an open boat within a few yards of the Swansea-pier, without striking against it. A wall built across a river would effectually stop the running of the stream; so also a vertical wall in the sea, as long as it stood, would check any current at right angles to its faces; the boat containing Professor Airey stood no chance of striking against the pier unless the water could flow freely through it (which was impossible.) If there were any current within a few yards of the wall it must have been parallel to, and not at right angles with its faces. A similar effect may be witnessed if the pier of a bridge in a running stream be made flat to the stream, as represented in the following diagram. A cork at *a*



would float in its position without being in any danger of striking against the masonry B, the water here being stationary. But who can say that the pressure of the stream on the bridge is less on that account? Indeed it appears to me that there is a perfect analogy between the piers of a bridge and a sea wall, and that if we admit the arguments in favour of a vertical wall we should be justified in adopting the flat-sided pier, instead of the pointed cutwater universally used.

Secondly. A vertical wall to resist an impelling force is much weaker than one with a sloping face, both because it stands upon a less base and depends upon the bonding of the stones for its security, whilst the wall having an exterior slope presents a larger base to resist the force of the waves, and the stones being in the natural position, are not so liable to be disturbed.

On the whole, the question appears to come to this: Is it wiser to resist the violence of the waves by breaking them and receiving the force in detail up an inclined plane—or to resist it unbroken by a perpendicular face? The first would undoubtedly be more liable to injury in places, for single stones or even yards may be shifted, but such damage might be easily repaired; while a vertical wall, if once penetrated would be destroyed inevitably.

I cannot think therefore that it is prudent to abandon a principle, which experience has proved to be efficient in practice, for one which, to say the most of it, is altogether theoretical.

I remain, Sir, yours obediently,

M.

London, May 18, 1848.

SEA-WALLS—SHOULD THEY BE SLOPING OR VERTICAL?

Sir,—Your review of "the Account of the Plymouth Breakwater, by Sir John Rennie," and the subsequent publication of an Abstract of the Report of the Dover Harbour Commissioners, together with the Protest of Sir Howard Douglas, seem to have attracted the attention of many of your readers to this most important subject.

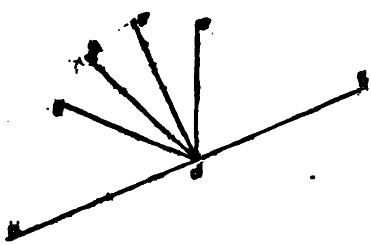
Local circumstances always influence the design in every class of engineering work; therefore, with regard to the general plan proposed, I have nothing to say, but shall confine my remarks entirely to the consideration of the form of wall proposed, and particularly at present to the inclination proper to be given to the sea face.

All the arguments that have been urged in support of the theory of vertical walls, are founded on the supposition that the motion of the sea during a tempest is wholly vertical—that the waves would oscillate without breaking upon the perpendicular face of the wall, and merely cause a varying pressure against it. I have carefully perused the Report of the Commissioners, and cannot see sufficient to justify such a conclusion.

Instances are adduced where the gradual slope has failed; but, generally speaking, the injury was of a partial kind, and either done during the progress of the work or before the mass became sufficiently consolidated; and in every instance the injury has demonstrated the value of the slope by decreasing its angle of elevation. Many engineers of eminence, and scientific men of high reputation, are in favour of vertical walls. But, on the other hand, there are also many engineers who oppose the doctrine, whilst the past experience of Smeaton and Rennie can well afford to be placed in juxta-position with the theory of Professor Airy (I speak with every respect towards the Astronomer Royal).

Daily experience shows us that the wind, which is the cause of motion in the sea, moves in a horizontal direction, and urges paper, leaves, dust, and other light particles of matter in the direction in which it blows. Does it not appear reasonable, therefore, that the sea, upon the waters of which the wind has such almost unlimited power, should be similarly influenced?

It has been urged that a vertical wave falling upon the sea slope of a breakwater, would break by the force accumulated in its descent, and that the water thereof would be urged with great violence up the inclined plane. Now, so far is this from being the case, that it is just the reverse of what actually occurs. For the slope, instead of facilitating the flow of water up it, tends to throw it back again towards the sea, as may be easily demonstrated by reference to the following diagram, in which



a b represents the sea-slope, and *c d* the vertical direction of a wave. Draw a perpendicular line, *c d*, from *a b*, at the point *d*, at which the wave would strike. It is a well-known property in physics, that the angle of percussion is equal to the angle of recoil; consequently, *edc* = *cdf*, and *df* would be the direction in which a vertical wave would recoil from the inclined plane, *a b*, which, being acted upon by gravity, is still farther deflected to the line, *d g*. Thus, then, if the water of the sea during a gale had only a vertical motion, it should, when breaking on the slope, be urged in the direction *d a* towards the foot, instead of in the direction *d c*, towards the summit of the slope. And the stones which, during the gales which damaged the Plymouth Breakwater, were flung landward, would have been found at the foot of the incline.

Mr. Thomas Stevenson's excellent experiments show, beyond question, that there is a very great horizontal pressure in the motion of the sea. His marine dynanometer registered nearly three tons per square foot during a gale off the Skerryvore Rock. This could not possibly be the result of vertical oscillation only; for the statical pressure of the highest wave would not amount to one half of it. Neither could it have been the result of impact from the effect of a vertical wave; for during the transmission of the force of a wave from a vertical to a horizontal line, a sufficient interval of time would elapse to prevent this. Spray is often thrown 100 feet above the crest of the highest wave. If the cause of this were investigated, it would not be found to proceed from the rising and falling of the wave; for it is impossible that the vertical oscillation of a wave 30 feet high can dash spray to the height of 120 feet.

The stability of a wall, by which I mean its resistance *en masse* to an overthrowing force, is compounded of its weight and breadth. It is evident that a wall with a sea slope possesses these qualities in the highest degree.

A wall with a vertical face must be composed of hewn stone, and depends for its strength upon the bond: if, therefore, the stone composing the wall be once shaken in its bed, nothing can restore the stability of the mass.

On the other hand, when the breakwater is composed of rough blocks which are suffered to find their natural inclination, the damage arising from storms is entirely superficial; for though a few hundred tons of stone may be heaved from their place by the violence of the

gale, this, so far from producing any serious injury, has quite a contrary effect, by tending materially to consolidate the mass.

I will take an early opportunity of returning to this most interesting subject.

I am, Sir, yours, &c.,

WILLIAM DREDGE.

10, Norfolk-street, Strand, June 18, 1848.

FRAGMENT ON LOGIC. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

Fully sensible of the value of the recently published researches of Mr. Boole on the Science of Logic, I feel it right to point out what I deem a misconception on the part of that learned writer.

Mr. Boole has observed, that

"Those relations which logicians designate by the terms conditional, disjunctive, &c., are referred by KANT to distinct conditions of thought. But it is a very remarkable fact, that the expressions of such relations can be deduced the one from the other by mere analytical process."*

It is true that KANT has (*Logic*,† p. 151) stated that categorical, hypothetical, and disjunctive judgments "depend upon essentially distinct logical functions of the understanding" .... But I think that the following quotations and remarks will make it clear that the NEWTON OF METAPHYSICS was quite aware of the connection between disjunctive and other judgments.

In the note at p. 113 of his *Prolegomena*‡ KANT, speaking of the table of the Categories, says "that the third" of each class respectively, "arises from the first and the second conjoined in one conception ...". Again, in his *Critick of Pure Reason*,§ he observes "that the third Category always arises from the combination of the second with the first of its class." And he illustrates this by saying, that "*Wholeness* (Totality) is nothing else but plurality considered as unity; *Limitation*, nothing else but reality combined with negation; Community is *causality* of a substance in determination reciprocally with others; lastly, *Necessity* is nothing else but the existence which is given through possibility itself ..." [He then goes on to state that since this combination is effected by a particular *actus* of the understanding, the third Categories are primitive and not merely deduced conceptions of the pure understanding. This last statement explains the extract, which I have above given, from his *Logic*.] Now—

The Categories have each as a basis a particular form of Judgment. These Judgments correspond in their properties with the respective Categories which are founded on them. Hence the *disjunctive* judgment which corresponds to the Category of Community arises from the combination of a categorical and a hypothetical judgment. KANT has not, that I am aware of, *explicitly* shown this, though he has *implicitly* affirmed it, as I have just pointed out. It may however be proved as follows: Suppose that

A is B + C‖. .. (1.), and that—If A is B, A is not C ... (2.)

combining (1) and (2) we infer that A is either B or C—a disjunctive judgment. And this *disjunctive* judgment may also be arrived at by combining the *two categorical* judgments

A is B + C ... (1.) and, that which is B is not C ... (2.),

and this last mode of derivation would be equally in conformity with KANT's view of the disjunctive judgment.¶

2, Church-yard Court, Temple, June 7, 1847.

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* *Cambridge and Dublin Mathematical Journal*, vol. iii., p. 197.

† Translated by John Richardson. London, 1819.

‡ Same translator and date as the *Logic*.

§ P. 84 of the Translation, published by Pickering. London, 1838. Read the whole of the *Second Observation*, pp. 84—85.

‖ By B+C is meant the whole class formed by the junction of class B and class C, and consequently (1.) asserts that A is contained somewhere in the class formed by the junction of B and C, not that A is *both* B and C. The following illustration will perhaps be considered as not improper. Let B and C be conceived as equal semicircles on opposite sides of the same diameter, then B+C denotes the whole circle. Let A represent another space then by "A is B+C" it is intended to be alleged that A is within the circle, but nothing is intended to be asserted respecting its position with reference to the semicircles B and C.

¶ *Critick of Pure Reason*, (Translation) p. 75.

TIBBIT'S SPRING HOLDFAST FOR WINDOW SASHES.

[Registered under the Act for the Protection of Articles of Utility. William Bullock Tibbits, of Braunston, in the County of Northampton, Gentleman, Proprietor.]

Fig. 1. Fig. 2. Fig. 3.

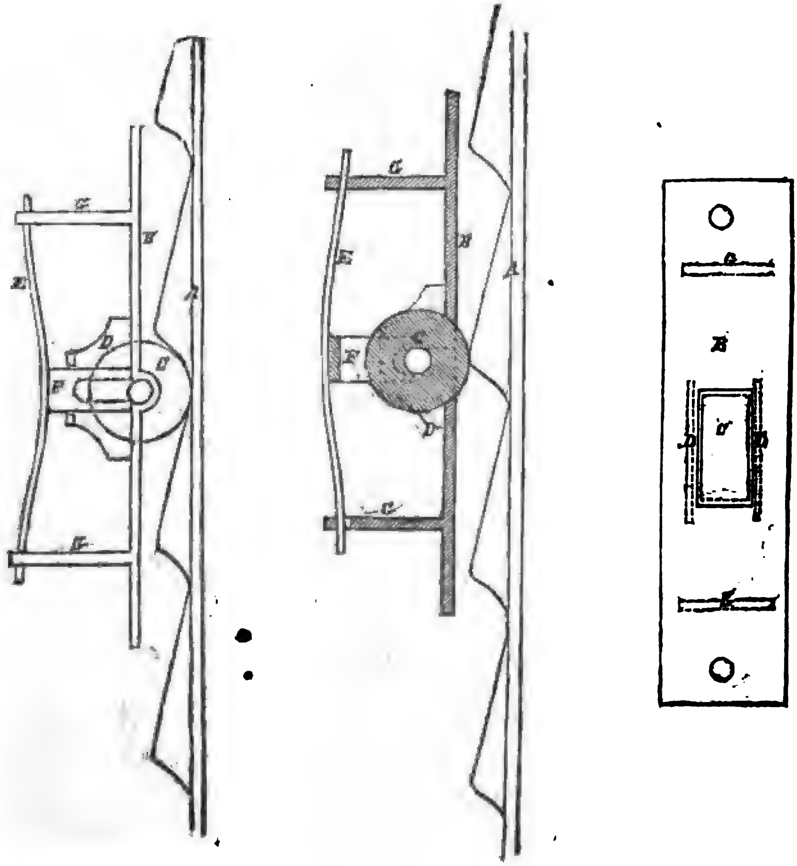


Fig. 1 is an elevation, fig. 2 a section, and fig. 3 a plan of this holdfast. To every sash there may be two such holdfasts, one on each side; or, in some cases, one only may suffice. Each holdfast consists of the several parts marked A, B, C, D, E, F, and G. A is a rack, which is affixed to one side of the sash; B, is a plate of metal, which is let into the grooved recess in which the sash runs, on the side of that recess opposite to the rack; C, is a roller, which is mounted in the plate, B, the ends of its axis resting in slots cut in the cheeks, D D, which are either either cast in one piece with, or otherwise affixed to the plate, B. E is a bow-spring, which is attached at the middle to the back of the saddle-piece, F, and has its two end bearings in the projecting pieces, G G. The sides of the saddle-piece rest on the axle of the roller, C, so that as the spring attached to this saddle-piece has, in its normal state, a constant pressure outwards, it keeps while in that state the roller constantly projected a little way beyond the face of the plate, B, and interlocked between two of the teeth of the rack, A, as shown in fig. 1.

When the sash is raised or lowered

the roller yields instantaneously to the horizontal pressure resulting from the vertical movement of the sash, and consequent action of the rack-teeth upon it, and returns as instantaneously to its original holdfast position on the cessation of that horizontal pressure.

SPARKS'S RAILWAY DISPATCH AND CASH-BOX.

[Registered under the Act for the Protection of Articles of Utility. John Sparks, of 12, King-street, Tower-hill, Builder, Proprietor.]

Fig. 1.

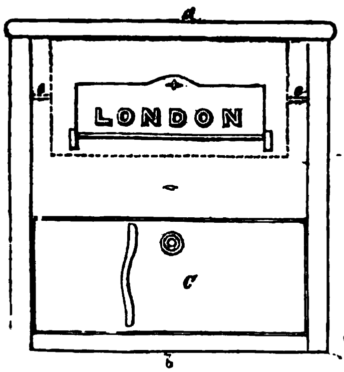


Fig. 2.

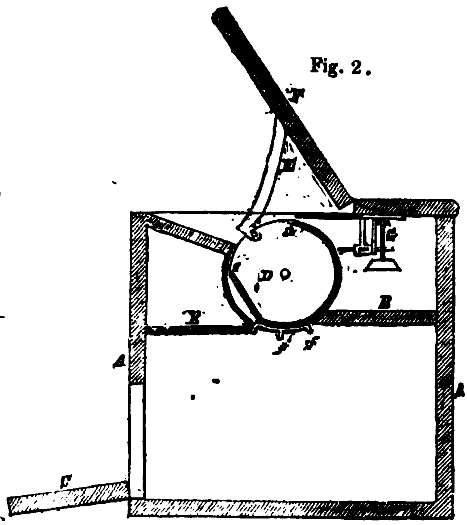


Fig. 1 of the above engraving is a front elevation of this box, and fig. 2 a sectional elevation on the line *a b* of fig. 1. A A, is the external shell of the box which is divided longitudinally into two compartments by the partition, BB; the lower compartment is for the reception of the articles to be conveyed, which are removed therefrom, at their destination, through the locked door, C. The upper compartment contains a cylinder, D, which is open on one side from *c* to *d*, and is suspended on central pivots, *e e*, which have their bearings in the ends of the box, so that the cylinder is free to turn upon them. E is one of a pair of connecting bars (there being one to each end of the cylinder) which at the upper end is joined to the fly-lid, F, of the box, and at the lower end to the cylinder, so that when the fly-lid is lifted up, the open side of the cylinder is uppermost, and ready for the reception of the articles to be transferred to the box. When the lid is let down upon the box the cylinder is turned round, and the goods fall into the lower compartment, from which they can only be taken through the door, C. G is one of a pair of sliding bolts which admit of the cylinder turning round only at such time as the box is standing in an upright position, and by coming against the projecting pins, *f f*, render it impossible to take anything from the box through the cylinder by turning it into any other position.

We think this apparatus meets more completely all the desiderata of the case than any other which has yet come under our notice.

SOFTENING IVORY.

Sir,—In your Number for July 1, you state in reply to "Y. X.'s" inquiry respecting the treatment of ivory, that "to soften is, in fact, to decompose and destroy it," and "according to all past knowledge and experience, it does not admit of being either

moulded or embossed," &c. Permit me, through the medium of your valuable Journal, to inform your correspondent that about two years ago, a person named Maison, residing in Paris, invented a process of softening ivory so as to render it capable of receiving any required impression, and of being manufactured into articles of utility and ornament, such as chairs, cabinets, baskets, vases, &c. I must acknowledge that objects manufactured by this process do not present so elegant an appearance as those made of carved ivory; but M. Maison's invention offers this advantage; that its cheapness would admit of the more general employment of ivory, the use of which substance is now greatly restricted owing to the trouble and expense of carving.

I believe that Maison was desirous of introducing his invention into England, but that the price he asked for the secret was much too high to tempt a purchaser.

I have the honour to be,

Sir, yours very respectfully,

EBUR.

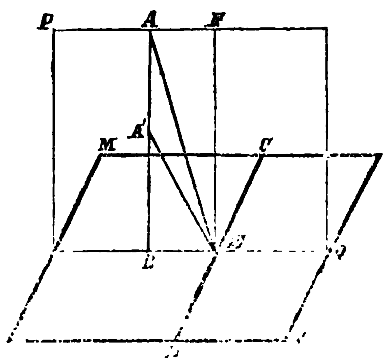
London, July 5, 1848.

GEOMETRY OF THE LINE AND PLANE.—BY T. S. DAVIES, F.R.S., L. AND E., F.S.A., ROYAL MILITARY ACADEMY, WOOLWICH.

(Continued from page 465.)

PROP. XLI.

If from any point lines be drawn, one perpendicular to a plane, and the other perpendicular to a line in that plane: then the plane through the lines so drawn will be perpendicular to the line in the plane.



From the point A let a perpendicular AB be drawn to the plane MN, and AE perpendicular to a line CD in the plane MN; then if the plane PQ be drawn through AB, AE, it will be perpendicular to the line CD.

For, in the plane PQ draw EF perpendicular to BQ. Then, since the plane PQ is drawn through AB, and AB is perpendicular to MN, the plane PQ is perpendicular to MN. (*prop.* 31.); and since EF is drawn in the plane PQ perpendicular to BQ, the intersection of MN, PQ, and PQ is itself perpendicular to MN, the line EF is perpendicular to the plane MN. (*prop.* 32.) Whence EF is perpendicular to ED. (*prop.* 24.)

Also, AE is perpendicular to ED by hypothesis; and hence the lines AE, EF in the plane PQ are both perpendicular to the line CD, and the plane PQ, therefore, itself perpendicular to CD. (*prop.* 24.)

COROLLARIES.

This proposition admits of many modifications in the form of its enunciation, some of which are better adapted to particular purposes than others. Two of these, as well as two simple deductions from the proposition, are annexed.

1. If AB be perpendicular to the plane MN, and CD be a line in the plane MN, and if BE be drawn perpendicular to CD, then all lines drawn from E to the perpendicular AB will be perpendicular to CD.

2. If AB, CD, MN, and BE be drawn as just described, and perpendiculars to CD be drawn from points in AB, they will all meet CD in the same point E.

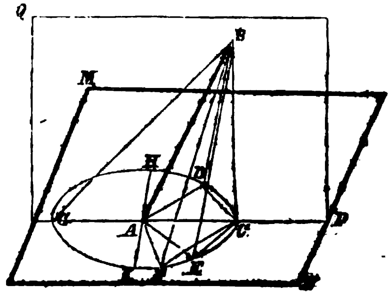
3. Under the same hypothesis, any line EA′ drawn to meet AB will be perpendicular to CD.

4. Of the lines drawn from E to AB, the line EB in the plane MN is the least: and that (EA′ in the figure) drawn to the point of AB nearer to B is less than the more remote.

Prop. XLII.

If a line be inclined to a plane, and lines be drawn in the plane from the point where the inclined line meets it, the angles formed by the inclined line with the lines so drawn will be subject to the following relations:

(1.) *The acute profile angle is the least of all.*
(2.) *The obtuse profile angle is the greatest.*
(3.) *The angle formed with the line least inclined to the acute profile trace is less than that formed with the more remote one; and*
(4.) *Only two of these angles can be equal, one lying on one side of the profile plane, and the other on the other.*
(5.) *One line, and only one, can be drawn in the plane perpendicular to the inclined line.*



(1, 2.) Let AB be a line inclined to the plane MN, and let lines AC, AD, AE, AF, AG, be drawn in the plane MN; and let BAC be the acute profile angle, and BAG the obtuse one: then BAC is the least, and BAG the greatest of all the angles which can be so formed.

(1.) For let BAE be any other angle; about A in the plane MN describe the circle GCE; and from C in the profile plane draw CB perpendicular to AC.

Then, BC is perpendicular to the plane MN (*prop.* 32); and hence BE is greater than BC (*prop.* 28.) Consequently since the two sides AB, AC are equal to the two AB, AE, but the base BE greater than the base BC, the angle BAE is greater than BAC. The acute profile angle BAC is therefore the least angle.

(2.) Again, since GC is the diameter of the circle GEC, it is greater than the line EC in the circle (*Euc. iii.* 15): wherefore the line BG is greater than BE (*prop.* 28.) Whence, BA, AE are equal to BA, AG, but the base BG greater than the base BE; and the angle BAG is hence greater than BAE. The obtuse profile angle BAG is therefore the greatest angle.

(3.) Let AE be nearer than AF to the acute profile trace; then the angle BAE will be less than BAF.

For, join BF. Then since the angle CAF is greater than CAE, the subtending chord FC is greater than FE; or F is more remote from the perpendicular than E is. Whence BF is greater than BE. Consequently BA, AE are equal to BA, AF, but the base BE less than the base BF; and hence the angle BAE is less than BAF.

(4.) There can be drawn one, and only one, line in the plane MN, which shall make an angle equal to BAE.

For, make the angle CAD equal to CAE, and join BD.

Then, since the angle CAD is equal to CAE, the chord CD is equal to CE; and hence the line BD to BF (*prop.* 28.) Wherefore (*Euc.* i. 8) the angle BAD is equal to BAE. There can, hence, be one angle equal to any selected angle BAE.

There can be only one: for all the others on the side GEC of the plane QC are either greater or less than BAE, as has been proved; and it follows in the same way that all those on the other side of QC are either greater or less than BAD, and hence than BAE.

(5.) Draw HAK perpendicular to GC in the plane MN. Then, GC is the intersection of two planes MN, PQ, and HK is drawn in one of the planes MN perpendicular to GC, it is perpendicular to the plane PQ; and hence to the line AB in that plane. Whence one line can be drawn in the plane MN perpendicular to AB.

There can be but one: for then it would also be perpendicular to PQ, which is impossible (*prop.* 26.)—(*To be continued.*)

Sir,—The thunderstorm which visited us last night afforded an excellent opportunity to those who delight in observing natural phenomena, and in admiring the majesty which pervades the works of the Creator.

Since the Polytechnic Institution has been re-opened, some interesting lectures have been delivered there on the subject of thunderstorms, and I have no doubt that such of your electrical readers as are resident in London have already become acquainted with the novel effects which Mr. Baggs presents to his audience. But to your numerous country readers, who are dependent on secondary evidence, I think a short account of these valuable additions to science will be acceptable, and it may excite a desire in all to push onwards in that hitherto unexplored region which is now opened to our researches.

The leading improvement which marks Mr. Baggs's mode of discharging Leyden phials when arranged in a battery, is one which I believe has been suggested long ago, but has certainly never been carried out in practice on such a scale as we may now witness in the lecture-room of the Polytechnic. Electrical batteries are generally so constructed as to have all the interior coatings of the jars connected to one end, and all the exterior coatings to the other end of the circuit.

Mr. Baggs insulates each jar completely, and at the instant of discharge brings the interior of one jar to bear upon the exterior of the next, and so on in succession throughout the series.

By this modification, the new battery is made analogous in its operation to the galvanic battery; and the difference between the ordinary Leyden batteries and those of Mr. Baggs is exactly that which would be observed between a galvanic trough where all the positive and all the negative plates are respectively united, and another on the customary cellular or repetition plan.

We have thus a new feature introduced into our manipulation of Franklin electricity—the simultaneous change in position of each jar of the battery; and whilst its first results enable the electrician to exhibit a disruptive spark of great power, we can set no limitations to the expectations we may indulge in from its full development.

The battery employed by Mr. Baggs consists of ten or twelve large jars, each of which is supported horizontally on an insulating pedestal, which is capable of rotary motion about its vertical axis.

These jars are arranged in a circle, and are charged separately by the steam electric-machine. The amount of electricity imparted to each jar is regulated by an ingeniously contrived electrometer which answers the purpose of a safety-valve.

I subjoin a description of this self-acting regulator, although I believe that it is not altogether new either in principle or construction.

Fig. 1 represents a ground plan of a battery of this new form, the five jars of which are supposed to be separately charged.

By means of a simple motion given to a system of rods connecting the pedestals of all the jars, the battery is brought into the position indicated in fig. 2; the rotation of each having been in the direction of the arrow. It will be observed that the inner surface knob of each jar is now within "striking" distance of the outer surface of the next succeeding, and by this means the accumulated force of the whole battery discharges all the jars at once, and the spark restoring equilibrium passes through the space A B, which in Mr. Baggs's battery is extended to about *three feet!*

Fig. 3 represents the electrodynamic regulator referred to above.

A and B are two stationary metallic balls, the former of which is connected with the earth, the latter with the jar about to be charged.

The ball C is borne at the end of a metal balance-rod R, moving vertically about the fulcrum F, and is weighted at W according to the intended maximum intensity of the charge. The electricity is transmitted from the machine by the wire P, along the rod, and through the balls C and B to the jar.

The balls C and B being affected with electricity of the same sign, will repel each other, and when the repulsive force becomes strong enough to separate them, the rod will assume the position indicated by the dotted lines, until the ball C coming within "striking" distance of A, the surplus electricity will pass off to the earth.

At the risk of unduly protracting this communication I shall add a few of Mr. Baggs's observations on thunder and lightning.

The prolonged roar of a thunder peal, so unlike the sharp report of an ordinary electric discharge, is generally attributed to the reverberation of the first sound by surrounding objects; but thunder heard at sea or on a level plain, cannot owe its duration to such succession of echoes.

Mr. Baggs explains this difficulty, as well as the devious zigzag course of lightning, by the following theory:

The clouds consist of strata or aggregations of vapour, and each mass includes a number of small particles of vapour. Let fig. 4 represent a number of these masses and small particles. Then any one particle, A for instance, will be similarly charged throughout, but the exteriors of all will by induction be charged dissimilarly. The spark will pass between two bodies similarly charged by the common tangent, and between two dissimilarly charged along the common normal.

Hence there will be a succession of cumulative discharges, forming a flash, whenever the masses of charged vapour are brought into such a position as to consist of groups arranged as are the jars in fig. 2.

Some of your readers may have noticed as I have done that the figure of a flash of lightning does not always appear to be produced on the retina of the eye with all its parts apparent simultaneously. Often it seems to resemble a swift meteor, and one extremity of the light disappears whilst the other is projected farther. This is intelligible enough if we consider each flash to consist of innumerable small discharges between contiguous masses. The *direction* of its course will then be influenced by the relative positions and electrical affections of the various masses of vapour, and the duration will depend on the rapid accumulation in each mass, of an amount of electricity which finally (but often not until after an appreciable time) exceeds what can be sustained by the particle or mass under the circumstances. This distinction between one spark and a flash of continuous discharges is exceedingly important. It was beautifully illustrated by Faraday in one of his late lectures, where the electric current was so retarded

Fig. 1.

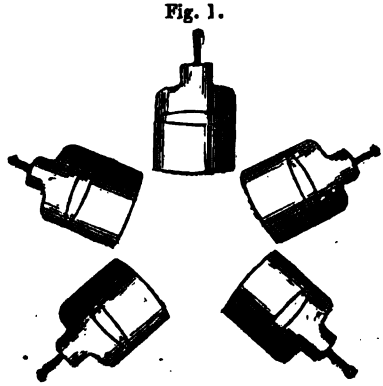


Fig. 2.

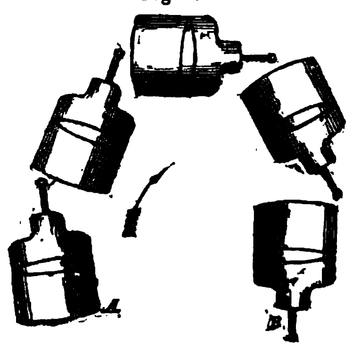


Fig. 3.

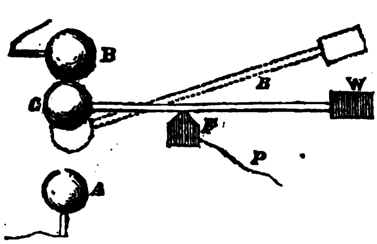
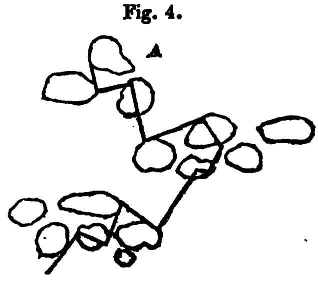


Fig. 4.



and wire-drawn by compelling it to traverse an imperfect conducting medium, as to produce effects, such as firing gunpowder, necessarily requiring an appreciable duration of the heating power generated by its passage.

In conclusion, I would beg leave to propose flat cells as a convenient form for the jars of the new battery. They should be broad enough to admit the hand for coating with tinfoil, and large enough to render the separate charging of them not too troublesome.

Yours, &c.,

JOHN MACGREGOR.

24, Lincoln's-Inn Fields, July 15, 1848.

SELF-ACTING SLUICES.

Sir,—On examining the embankments which have been constructed throughout the united kingdom for the reclamation of slob lands from the tidal waters of the sea, two descriptions of self-acting sluices, at least, may be observed differing in no other particular but in the length of the arms by which they hang suspended from the axle.

Fig. 1.

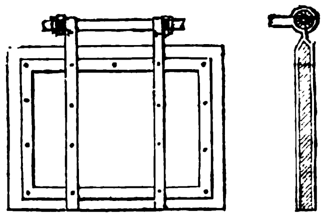
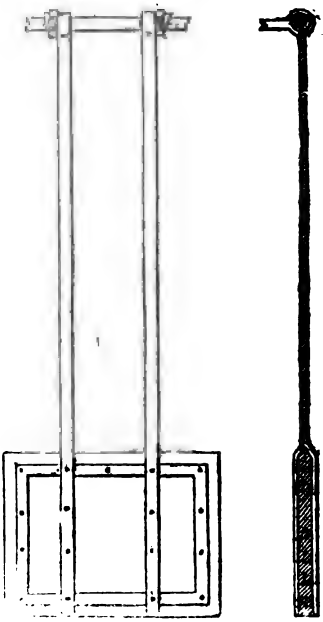


Fig. 1 of the accompanying sketches shows one of these sluices whose line of suspension is immediately above the top of the sluice; and fig. 2, one which hangs by long rigid arms from a line at least 10 feet above the top of the sluice. You are aware that the use of these sluices is to exclude the sea water at high tide; and at a particular state of the ebb, the pressure of the fresh waters within the embankment opens the sluices, and thus the flood waters of the country escape through the tunnels from the reclaimed lands to the sea.

To ensure the most effective system of drainage from more rich low lands, which otherwise would become saturated and materially damaged, the efficiency of dis-

Fig. 2.



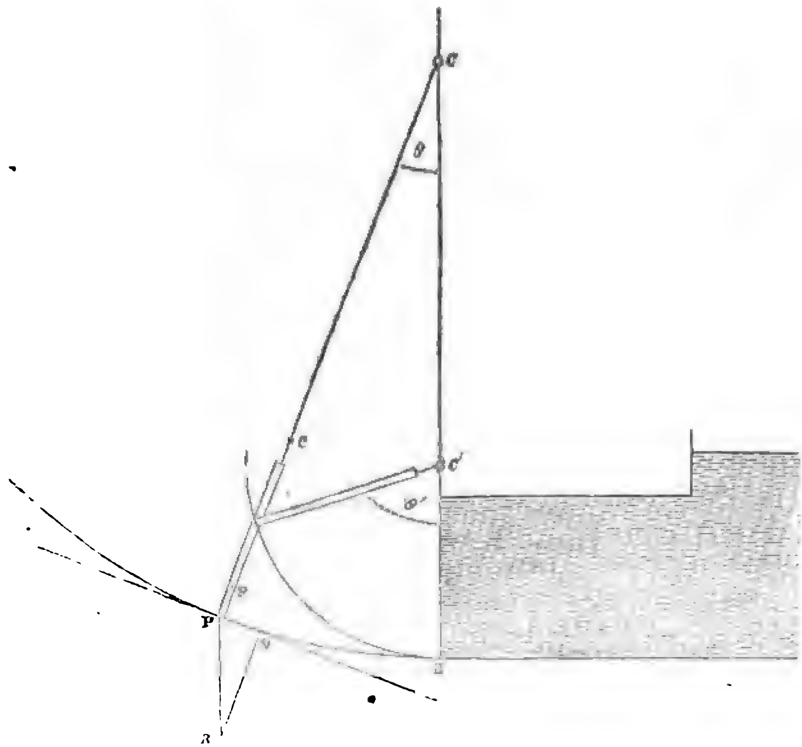
charge through the sluices, which can act but a limited time during each tide, is of the utmost importance; and as each of the sluice forms above referred to has been adopted in important situations by engineers of unquestionable experience and ability, the following investigation of the mechanical laws which govern their action, showing the efficiency of discharge in each case, may not be altogether without interest to some of your readers.

Let P C (fig. 3) be any position of the long armed sluice, making with the vertical B C the angle B C P $=\theta$. The point P is held in equilibrium by three forces; viz., the force of the water acting in the direction Q P, the weight of the sluice and arms acting in PR, and the tension of the rigid body reacted at the point C.

Resolving the force, PR, into the two equivalents, QP, RQ, respectively perpendicular and parallel to PC, the latter is destroyed by the re-action at C, and the remaining equivalent, QR, being the tangential force, is the only one opposed to the direct action of the fluid.

Take F, the centre of pressure of the fluid, and G the centre of gravity of the

Fig. 3.



mass of the sluice and arms together; put PF = Z, PG = Z′ and PC = a. Then FC = $(a - z)$ and GC = $(a - z')$: also put PR = W = the whole weight of the mass.

Now the angle PRQ is obviously equal to PCB = θ, and ∴ W. sin. θ = PQ = tangential force; and if P represent the force of the water upon the sluice, we have

$$P.(a - z) = W.\ \sin.\ \theta\ (a - z')$$

an expression for the conditions of equilibrium, supposing the system placed in air.

Suppose the whole now immersed in water, as the sluices must be; the force of *buoyancy* upon the material would at once destroy the equilibrium exhibited above, and therefore this force must occupy a place in the equation. Putting M = the mass of the sluice immersed, d = the distance of its centre of gravity from the centre of motion C, and n = the specific weight of water. Then,

$$P.(a - z) - m.\ n.\ d.\ \sin.\ \theta = W.\ \sin.\ \theta\ (a - z');$$

so that the conditions of equilibrium *in water* between the resultant of the weight of the sluice and that of the water, are generally,

$$P = \frac{W.(a - z') + m.\ n.\ d}{(a - z)} \cdot \sin.\ \theta.$$

By an exactly similar process we should find for the sluice with the short arms

$$P = \frac{W.'(b - x') + m.\ n.d'}{(b - z)} .\ \sin.\ \theta',$$

in which w', b, x', d', and θ', represent in this case quantities respectively similar to those represented by w, a, z', d, and θ in the first case. Equating therefore these two values of P, we have

$$\frac{\sin.\ \theta'}{\sin.\ \theta} = \frac{W.\ (a - z') + m.\ n.\ d}{W.'(b - x') + m.\ n.\ d'} \cdot \frac{(b - z)}{(a - z)},$$

which gives the ratio of the angular openings of the sluices due to a given pressure, P, and therefore a direct comparison of the efficiency of discharge in each case.

From the last equation it is manifest that as the total weight of the short

armed sluice must be *less* than that with the long arms, the ratio of

$$\frac{\sin.\ \theta'}{\sin.\ \theta}.$$

must be greater than unity; *i. e.* the angular opening of the short armed sluice must be always *greater* than the angular opening of the long one, the pressure being the same in each case.

The preceding investigation is abundantly simple and easy of comprehension; but algebraic formulæ, however simple in their nature, are too often viewed in an unfavourable light by the general reader and ordinary arithmetician. The application, therefore, of the results above obtained to a particular case, in which I have accurately ascertained the numbers represented by the symbols, may place the subject in a more practical point of view.

In the case to which I allude $W=506$ lbs., $(a-z')=96$ inches, $m.\ n.=266$ lbs., $d=120$ inches, and $(b-z)=50$ inches. Also, $W'=393$ lbs. $(b-z')=36$ inches, $d'=41$ inches, and $(a-z)=128$ inches.

Substituting these values in the equation, we have

$$\frac{\sin\ \theta'}{\sin\ \theta}=\frac{506\times 96\times 50+(266\times 120)}{393\times 36\times 128+(266\times 41)}=1.3506,$$

the ratio of the angular openings in this particular case.

Now, assuming certain angular openings for the short-armed sluice, let us see what would be the openings due to the long sluice for the same pressure.

$\theta'=5°$...... log. sin.	$=8.940296$
1.3506 log.	-0.130507
	$8.809789=3°\ 42'$
$\theta'=15°$ —	9.412996
1.3506	0.130507
	$9.282489=11°\ 3'$
$\theta'=30°$	9.698970
1.3506	0.130507
	$9.568463=21°\ 44'$
$\theta'=45$	9.849485
1.3506	0.130507
	$9.718978=31°\ 35'$
$\theta'=60$	9.937531
1.3506	0.130507
	$9.807024=39°\ 53'$
$\theta'=90$ (horizontal)	10.000000
1.3506	0.130507
	$9.869493=47°\ 46'$

Here, then, are the practical deductions from the preceding investigation.—The force capable of opening the long-armed sluice,

3° 42′	— will open the short sluice	5°.
11° 3′	—	15°.
21° 14′	—	30°.
31° 35′	—	45°.
39° 53	—	60°.
47° 46	—	90° (horizontal.)

There are other disadvantages besides those above exhibited—the inevitable result of the long arms; but what has been shown is perhaps enough to make it apparent that such a construction should never have been adopted.

T. Smith.

Bridgetown, Wexford, June 28, 1846.

THE GRESHAM PROFESSORSHIPS.

Third Notice.

We have been induced to look a little more closely into the history of the Gresham College (instead of trusting to our] memory of former readings upon a subject which, at that time, only interested us from its gross malversation) since the present vacancy in the geometry-professorship has come to our knowledge. Of course, we first referred to old Ward, who, in his "Lives of the Professors of Gresham College," has given the principal documents respecting its early history. We have, therefore, selected all those parts of Sir Thomas Gresham's will which relate to his college, and extracts from a description of the fundamental constitution of it, as detailed in the tripartite deed between the Corporation, the Mercers' Company, and the Gresham professors in 1597. We have not room this week to discuss this singular document, or compare it with the will: still less can we recount the subsequent scandalous perversions of this trust, effected by the act of Parliament in 1768 (8 *Geo.* iii. *cap.* 23,) by which the college has been virtually annihilated. It is to be lamented that this college did not come under the scrutiny of Lord Brougham's Committee, in 1817-18. The glaring enormity of its misappropriation would have stood out in bold relief even against the infamous case of "Spittle and mere,"—one of the worst cases that has ever found its way into the public records! We shall return to the subject, and sift it to the very bottom.

Sir Thomas Gresham, as we have said, was educated at Cambridge, under Dr. Caius, himself the co-founder with Dr. Gonville, of the college which bears their joint names. There was hence the *idea* of a foundation presented to his mind in early life; and there was prevalent in Cambridge a belief that he intended to add another college to that university. Indeed, there was addressed to him, by the public orator of that day, a fulsome letter, by order of the caput, to remind him of his "promise." What answer was given is, however, not known; but it is clear that the merchant-Mæcenas had long, ere that period, made up his mind. He had built for himself a "Mansion House" between Bishopsgate-street and his Royal Exchange, which was quite as remarkable for its extent as for its magnificence; the plan of which was that of a collegiate building, adapted to form "lodgings" for the professors, lecture-rooms, laboratories, and a noble gallery fitted for use on all public occasions. This was begun about 1560 even during the life of his only son, which shows how fully he had determined upon the foundation of his college. In 1575 he made his will—(written entirely with his own hand)—in which he endowed this college with ample funds, chargeable upon certain of his estates, amongst them the Royal Exchange; and left the Corporation of London and the Mercers' Company joint trustees. There were first appointed in one part of the will the four professorships, viz., of "divinitye, astronomy, musicke, and geometry," with "sallaries and stipendes" each "of fifty pound of lawfull money of England yerely." In a later part he adds the three professors of "lawe, phissicke, and rhetoricke," to each of whom he allots the same "stipende." Further on still, we find it ordained that the said trustees "shall permitte said seaven persons, by them from tyme to tyme to be elected and appointed in manner and forme aforesaid, meete and sufficiently learned to reade the said seaven lectures, to have the occupation of all my said mansion house, gardeins, and of all other the appurtenaunces, for them and every of them there to inhabite, study, and daylie to read the said several lectures. And my will is, that none shall be chossen to reade any of the said lectures so long as he shall be married, nor be suffered to reade any of the said lectures after he shall be married, neither shall receive any fee or stipend appointed for readinge the said lectures." This is all that occurs in the will relating to the endowment of, and conditions attached to, the Gresham professorships.

The statute of mortmain rendered it necessary that license should be obtained for the appropriation of his estates to this purpose within a certain period. He therefore adds, "that I doe require and charge the said corporations and governors thereof, with circumspect diligence and without longe delay, to procure

and see to be done and obteyned, as they will answer for the same before Almightye God. For if they, or any of them, should neglecte the obteyning of such lyssaunce or warrante, which I trust cannot be difficult (nor so chargable, but that the overplus of my rentes and proffittes of the premisses herein before to them disposed will soon recompence the same,) because to so good purpose in the common wealth no prince nor council in any age will deny or defeate the same (and if conveniently by my will or other conveyance I might assure it, I would not leave it to be done after my death); then shall the same revert to my right heires; whereas I do meane the same for the common weale. And then the defaulte thereof shall be to the reproach and condempnation of the said corporation afore God."

The entire will in detail is given by Ward in his "Lives of the Professors of Gresham College," (fol. 1740), but as the book is large and not very common, we have thought it advisable to extract all that relates in the most remote degree to the college, in order that our readers may see Sir Thomas Gresham's earnestness in the cause of learning, and the only restrictions which *he* made.

Some opposition to the will was made by Lady Gresham, but the trustees obtained an Act of Parliament which set the matter at rest, and they came into possession in 1596; and in 1614, a patent from the Crown was obtained "to hold them for ever upon the terms expressed in the will of the donor," (Ward, p. 32,) in conformity with the will of the founder.

An agreement tripartite between the Corporation, the Mercers' Company, and the professors, bearing date January 16, 1597, prescribes the objects of the college and the manner of lecturing. This very curious document is printed at length by Ward in his preface; but it would be too long for extract into our pages. We can only give a few passages which more immediately bear upon our present object.

The first paragraph recites the "chief care" of the trustees, "that the last will and testament of the said Sir Thomas Gresham touching his said mansion house, and the lectures there to be read, should be in all things truly performed *according to the intent thereof*"; and then proceeds to put "the seven persons already elected and appointed, &c., being meet and sufficiently learned to read the seven lectures," into possession of "all the said mansion house, gardens, and of all the other appurtenances, for them, and every of them, there to *inhabit, study, and daily read the said several lectures* mentioned in the said will and testament of the said Sir Thos. Gressham, *according to the true intent thereof.*"

The second paragraph prescribes that [besides the ordinary daily lectures? This is not very clear from the document] there shall be "certain several *solemn lectures*, with great care and dilligence to be performed, by every of the said lecturers in their several arts and sciences, at the several set days and times;" and the periods are fixed in the third and future paragraphs. The reasons for this are recited to be, "the *credit of the place, the more increase of learning, and the greater honour of the founder.*"

The fourth paragraph fixes the college-year at four terms, nearly corresponding with the common law terms; and the fifth we give entire:

"And forasmuch as the publick reading of the said lectures is to be performed in that manner, *as may most tend to the glory of God, and the common benefit of the people of this city*, WHICH WE DOUBT NOT TO BE THE PRINCIPAL ENDS OF THE SAID FOUNDER IN ORDAINING THE SAID LECTURES; and for that the greatest part of the inhabitants within the city understand not the Latin tongue, *whereby the said lectures may become solitary in a short time* if they be delivered in the Latin tongue only; and yet withal it is very likely that divers strangers of foreign countries, who resort thither, and understand not the English tongue, will greatly desire to hear the reading of the said lectures, whereby the memory of the said founder in the erecting of the said college for the increase of learning may be divulged, to the good ensample of foreign nations, and the honour and credit of this honourable city: it is thought meet, that the said solemn lectures be applied to the best benefit and contentation of the auditors of both sorts."

It is little likely that "divers strangers of foreign countries" would be resident in London at that time, except for commercial or semi-diplomatic purposes.

The latter class then held a very ambiguous position (see "Dee, John," Penny Cyclopædia,) which it would not have been political wisdom on the part of the citizens of London to harbour, succour, or encourage;" and the mere courtiers did not form a class likely to be interested in any collegiate learning. The "divers strangers" who came to England in conformity with "the wont of the wandering pilgrims of learning" of preceding times to travel *everywhere*, would go to Oxford generally (as the then most celebrated English university,) and occasionally to Cambridge, and not trouble themselves with a new college without European fame, and only, indeed, just commencing its existence. There are hence only two ways left us of looking at the ordination of this paragraph.

The first is,—that the trustees really intended to make the college of such efficiency, learning, and reputation, that it should attract *learned foreigners* to its lectures and exercises—*for the sake of study, and the acquisition of knowledge which could be nowhere else obtained.* If, however, this had been the case, how are we to account for the special character, and the attempt at rendering the lectures adapted to the capacity of the London citizens of that day, which runs through the prescriptions for the law, physic, and divinity lectures? This hypothesis must, therefore, be abandoned.

The second is,—that the trustees considered the "Latin tongue" to be the vernacular language of the merchants of Europe! Beyond "the service of the mass," it was as little known to the merchants of Holland, and Germany, and Italy, as it was to the English merchant and London citizen. The assumption was a simple absurdity—as much so then as it is now.

We can only look upon this *euphuism* (to use a term of that period,) and, indeed, many of the regulations contained in the entire document, as the result of a total misconception of the magnificent views of Sir Thomas Gresham, and as an attempt to give "a learned air" to the vulgar and common-place system of lecture which the trustees had, in their "practical wisdom," been pleased to ordain instead. Can anything, for instance, be conceived so absurd as the prescriptions for the lectures on astronomy and geometry, which are given a little further on? Yet even these, paltry as they are in reference to the science of this day, and not very exalted even in 1597, have not been adhered to either in their letter or their spirit. Even on the very foundation, the will and testament of the founder were perverted from the "true intent thereof." We cannot, then, much wonder at subsequent perversions, when we look at the status and wisdom of the trustees who have represented the City and the Mercers' Company through the several ages that have intervened.

The remaining paragraphs prescribe the days and hours of each week of each term the lectures shall be read, and lay down somewhat stringent regulations as to the manner of treating some of them. The general rule for time in the Latin lecture was from eight to nine, and the English from two to three; except the music, which is to be wholly in English (a dispensation to Dr. John Bull, who was "recommended by the Queen's most Excellent Majesty, he being not able to speak Latin,") between the hours of three and four on Thursdays and Saturdays. We take them in the order of the "agreement tripartite."

1. The *Solemn Divinity Lectures* (Wednesday) were to be wholly controversial, not "mingled with exhortations, being improper for a public lecture." This rule was made by the bishops; and it closes, "provided always, that he [the lecturer] shall not impugn any doctrine, order, rite, or ceremony, received and allowed in the Church of England."

2. The *Solemn Law Lectures* (Tuesday) are a little varied from the general scheme, inasmuch as they are to be read "for three quarters of an hour in the Latin tongue, and for the other quarter in the English tongue, which shall be a brief collection or recapitulation of that which was read in the Latin of the said lecture." This appears to be designed as a series of popular lectures for mercantile men; and *seventy-six* different heads, upon which the lecturer is expected to afford information, are actually laid down! The "university manner" of reading this lecture is formally set aside: which (on the law-principle that "the exception proves the rules") seems to imply that the other lectures were designed to be read "after the manner of the university."

3. The *Solemn Physic Lectures* (Monday) are prescribed somewhat oddly: "and *forasmuch as the greatest part of the auditory* is like to be of such citizens and others, as *have small knowledge or none at all in the Latin tongue*, and for that every man for his wealth's sake will desire to have some knowledge in the art of physick; it is thought good that *the first lecture be read in the Latin* and the second in the English tongue." Most people would have thought the very reason offered by the Trustees a valid one for rendering the lecture entirely in English! The course briefly prescribed was however a good and suitable one for the times and the purpose. We give the next entire.

4. "The *Solemn Lectures of Astronomy and Geometry* are to be made in like manner, viz., either of the said lectures twice every week, on Friday Astronomy, on Thursday Geometry, between the hours of eight and nine in the forenoon, and two and three in the afternoon; whereof the lectures in the forenoon to be in Latin, and the lectures in the afternoon to be in English. Touching the matter of the said solemn lectures, the Geometrician is to be read as followeth, viz., every Trinity term *arithmetique*, in Michaelmas and Hilary terms *theoretical geometry*, in Easter term *practical geometry*. The Astronomy reader is to read in his solemn lectures, first, *the principles of the sphere*, and *the theoriques of the planets*, and *the use of the astrolabe and staf*, and *other common instruments for the capacity of mariners;* which being read and opened, he shall apply them to use, by reading *geography* and the *art of navigation*, in some one term of every year."

5. The *Solemn Rhetoric Lecture* (Saturday) is merely prescribed as to time and language.

6. The *Solemn Musick Lecture* is to be delivered, "the theorique part for half an hour or thereabout, and the practique by concent [concert?] of voice or of instruments for the rest of the hour; whereof the first lecture to be in the *Latin tongue*, and the second in the English tongue." The dispensation before alluded to as granted to Dr. John Bull, appears to have become perpetual; and, indeed, though a music lecture in "that soft bastard Latin," (as Byron calls the Italian) might be very agreeable, it certainly would sound somewhat odd in the barbarous and bald old Latin of the schools, and not less so in the still more barbarous Latin of modern times. A musician's Latin would be a curiosity in its way.

The "Ordinances and agreements tripartite" close with the following bit of antique dandyism:

"Further, for more order and comliness sake, it is thought meet, that the said lecturers shall read their lectures IN THEIR HOODS, *according to their degrees in the universities*, in such sort as they should there read the same lectures."

None, therefore, by this decree, but members of the universities are eligible to these appointments. There were sapient and prescient legislators in those times; though, in many respects, there are traits of wisdom in this document that transcend even the conception of our modern city legislators. Still, it never entered into the imaginations of even the *better race* of city men, that any science could be cultivated effectively beyond the walls of a college and the magic circle of a university. Least of all did they dream that, within two centuries, the whole weight of the geometrical reputation of England should fall upon the shoulders of men who had not only never seen a university, but who were almost unknown, and where known, despised by the members of both universities. The last quarter of a century (and especially the last few years) have somewhat modified this relation; but yet, after mature deliberation (though we hazarded the remark a fortnight ago upon the impressions that had been made upon us by the mere recollections that occurred at the moment,) we are bold to say, that to the present hour, Mr. Potts is the *only man in either university who is* NOW *fairly before the world with any legitimate claims to be considered as the English representative of the geometry school of the universities.* Let the Gresham Committee (and especially the great corrector of *non-corporate* abuses, Sir Peter Laurie) look to it. He is ambitious of a name in civic and public history: he has now a chance—whether he promote the views of the only qualified university candidate that offers, or seek still further than university production, is a matter of small importance. Let him only do his duty, and

render these offices something different from the sinecures they have been, and he will earn and obtain the gratitude of posterity. We will reckon on him, and may success attend his efforts to cleanse his own civic Augean stable!

What are the present and the late Lord Mayors about? Are they, too, who should *guide* the "herd" whose names we gave last week, so little alive to the social state of the human mind in England, as to still take these abuses as a matter of course? Are they, too, so blind as to not perceive that the days of patronage and perversion are gone by? We pray them to *defer* this election, rather than elect an unfit man to carry out the *real designs of the founder*. Let them remember that, by "Geometry," *Sir Thomas Gresham meant* GEOMETRY; *and that neither* ACADEMIC DEGREES *nor* CITY INFLUENCE *with the* trustees *imply what* Sir Thomas Gresham meant by that word. Let them also look at his emphatic objurgation, and pause, ere they also commit themselves to public obloquy. If they be not satisfied with the best candidate that offers himself (though there is no real reason why they should not be) let them look still further. With the general impression respecting city and corporate influence (and especially with the restrictions quoted which excludes non-academic men) the Gresham Committee cannot command the highest possible talent and fitness in any department—except by mere accident. We only intreat the Gresham Committee, if they will not take the university candidate, by far the most fitted for the office, to pause ere they decide—to learn what geometry really is—to ascertain, as well as they can, who really are the eminent geometers of England—to select the highest—and *offer* him the appointment. No one of the many whom we could name, who are not of the university, will, we have the fullest assurance, *offer themselves* for that appointment. We have, however, no wish to disturb the regulation implied in the closing paragraph quoted above of the "tripartite" agreement. We suppose, however, that whatever difficulties else may stand in the way of non-academic men, the matter of the "hood" would form an insuperable barrier to their selection by the *aristocratic* Gresham Trustees. However, only let justice be done to ability, and justice to the public, and most of all justice to the will and intentions of Sir Thomas Gresham:—and then we shall be satisfied.

ROBERTSON'S PATENT IMPROVEMENTS IN THE MANUFACTURE OF TEXTILE FABRICS, STUFFS, AND TISSUES, AND OF CERTAIN NEW PRODUCTS OBTAINED BY THE AID OF SUCH IMPROVEMENTS. COMMUNICATED FROM ABROAD.

[Patent dated January 19, 1848. Specification enrolled July 19, 1848.]

Specification.

Whereas brocaded stuffs, in which the figures or designs are introduced in the process of weaving, possess an acknowledged superiority over surface-printed goods, look much better, and bring a higher price; but they are open to this objection, that the mode in which they are manufactured admits but of little variety in the figures, and is a great obstacle to freedom of design, besides being exceedingly complicated and difficult. The Jacquard loom, in which such stuffs are woven, requires as many distinct wefts as there are colours in the design; an immense number also of cards; and most elaborate ingenuity in the mounting. The more complex the design, the more skilful must be the workman; and be the workman ever so skilful, he can at best become the master of but a small number of patterns. Now, the nature or object of the said invention consists in giving to the patterns or designs of surface-printed goods the same clearness and distinctness, and the same high finish which have been hitherto peculiar to brocades; and in combining at the same time with this successful imitation of brocade work, that economy of production, and that power of varying the designs at pleasure which belongs to surface-printing alone. And the manner in which the said object is effected is as follows:

First. The colours used in this improved mode of surface-printing are prepared in a different way from what is usual. In general, they are not ground sufficiently fine, the consequence of which is, that they neither flow freely and equally, nor penetrate the fibres of the goods thoroughly; on some parts they make but a faint impression, while on others they rest in spotty superficial masses; and hence a prevailing want not only of clearness and continuity in the lines of the figures, but of fixity in large portions of the colours. To remedy these evils, the author of the present invention grinds the metallic oxides, the lacs, and other materials from which the colours are derived, to as impalpable a state as is practicable by the grinding-mill in ordinary use; employing no new machinery for the purpose, but applying the old more perse-

veringly and more carefully than heretofore. The colouring materials are then mixed with any of the thick fatty oils, in the proportion of about one-third part of the oil to two-third parts of the colouring material; and great care also is taken to make this mixture as intimate and complete as may be. The colours so prepared are applied to the engraved surfaces by rollers, in the usual way.

Second. To obtain plates which will yield impressions of the required vivacity, the following method is adopted:—A very thin plate of copper (*de deux à trois millimetres d'epaisseur**) is well cleaned and polished, and the designer draws his pattern upon it. The pattern is then re-drawn (*décalqué*); that is to say, the plate is cut through and through in those parts covered by the lines of the designer. And this done, the plate is attached, by soldering or riveting, to a foundation-block, in order that it may be printed from. In this way, an engraved or printing surface (in *intaglio*) is obtained, in which all the lines are not only much deeper than usual, but all perfectly perpendicular and square—that is to say, all at right angles with the surface, and as deep as they are broad; and obtained, too, at an expense much less than such work would cost if performed by any other known means.

Goods printed from such plates, and with colours carefully prepared in the way before described, are difficult to distinguish from the best brocades. The colours penetrate the fibres so completely, and the figures are so distinct and clear, that there is no necessity, as usual, for subjecting them either to steaming or to mordants, or to river washing, in order to fix and bring out the colours.

MESSRS. BROWN AND REDPATH'S PORTABLE SMITHS' FORGE.

Experiments were carried on in the blacksmiths' shop, at the Factory, Woolwich Dockyard, on Saturday and Monday last, before Mr. Lang, master shipwright, and Mr. Atherton, chief engineer, to test two portable smiths' forges, or heating apparatus, submitted by Messrs. Brown and Redpath. They are both on the same principle, only one is worked by hand, and the other by the foot, to allow the workman to use both hands in turning the iron in the fire, and are intended as substitutes for the cumbrous and inefficient forges at present used by the engineers, smiths, and armourers in the Royal Navy. The leather and wood of the common bellows being so liable to injury from insects and other causes in tropical climates; the forges made by Brown and Redpath are wholly of iron, and so compact that when folded up for stowing away, they do not occupy a space of three feet six inches by two feet six inches, and eight inches thick. The blast is produced by an eccentric fan, thirteen inches in diameter, with three blades, which revolves with great rapidity by means of an endless gut-band and crank-handle, making upwards of 2,000 revolutions per minute, and producing a more powerful blast than can be obtained by the common forges. The experiments were conducted by Mr. Chaplin, engineer to the firm, under whose superintendence the machines were constructed. He introduced pieces of iron 1¼ inches in diameter into the fires produced by the forges, and in four minutes the iron was brought to a good welding heat in the small one, and in 3½ minutes in one rather larger, set in motion by the foot. A piece of iron of the same dimensions was put into one of the fires produced by the engine-blast in the blacksmiths' shop, and it required 3½ minutes to bring it to a welding heat—exactly the same time as that required by the portable forge, showing a power of producing sufficient heat to enable engineers in charge of engines at sea to cast or repair many parts of the works which, without such aid, would require the return of the vessel to port to have them effected.—*Morning Chronicle.*

* From No. 14 to 20 Birmingham sheet metal gauge.

The Aid rendered by Mechanics to Agriculture.—At the first Exhibition of the Royal Agricultural Society in 1839, which took place at Oxford, there were but 23 implements exhibited. The number increased rapidly every year, till in 1844 it reached 948. During the two following years there was a falling off in the number of exhibitors; but since then there has been such a revival of the spirit of mechanical competition that the number of articles exhibited in 1847 at Northampton was 1,321, and this year, at York, no less than 1,508. In these numbers, however, there are included many old as well as new machines.

WEEKLY LIST OF NEW ENGLISH PATENTS.

William Swain, of Pembridge, Hereford, Brickmaker, for certain improvements in kilns for burning bricks, tiles, and other earthern substances. July 18; six months.

Jean Louis Lemanaude, of 30, Passage Jouffroy, Paris, jeweller, for a new process of applying or fixing letters of metal upon glass, marble, wood, and other substances. July 18; two months.

Charles Purnell, of Liverpool, clockmaker, for certain improved apparatus to be applied to timber-loaded and other vessels laden with materials, the specific gravity of which is lighter than water, preventing the necessity of abandoning them at sea, by ridding them of the superincumbent water, and enabling them thereby to carry sail. July 18; six months.

William Edward Newton, of Chancery-lane, Middlesex, for certain improvements in machinery for letter-press printing. July 18; six months.

Joseph Stenson, of Northampton, engineer, for improvements in steam engines and boilers; parts of which improvements are also applicable to other motive machinery. July 18; six months.

Joham Arnold Steinkamp, of Leicester-street, Leicester-square, Middlesex, gentleman, for improvements in the manufacture of sugar from the cane. July 18; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
July 13	1499	John Edmond Smith & Co.	Lawrence-lane, London	Shirt collar.
,,	1500	Charles Warren	Birmingham	Fastener for brooch.
14	1501	Richard Clark and Thomas Restell	West Strand, and York-terrace, Camberwell	Press and cullender for vegetables.
,,	1502	Fountain John Hartley,	Pump-row, Old-street-road	Fastener for umbrellas and parasols.
,,	1503	Foster, Porter, & Co.	Wood-street, Cheapside	Victorine.
15	1504	Thomas Heming	Maidstone	Shooting-coat and waistcoat combined.
,,	1505	Barnett Meyers	Crutched Friars	Mitred handle for walking-sticks, umbrellas, canes, &c.
17	1506	George Josiah Mackclean	Lechlade	Thrashing machine.
,,	1507	White and Wells	Nottingham	Under shirt.
18	1508	Thomas Edwards	Birmingham	Solid leather cigar case.
19	1509	George Unite	Birmingham	Slide bolt to secure the pins of brooches.
,,	1510	Weiss and Son	Strand	Forceps and scissors' joint.

CONTENTS OF THIS NUMBER.

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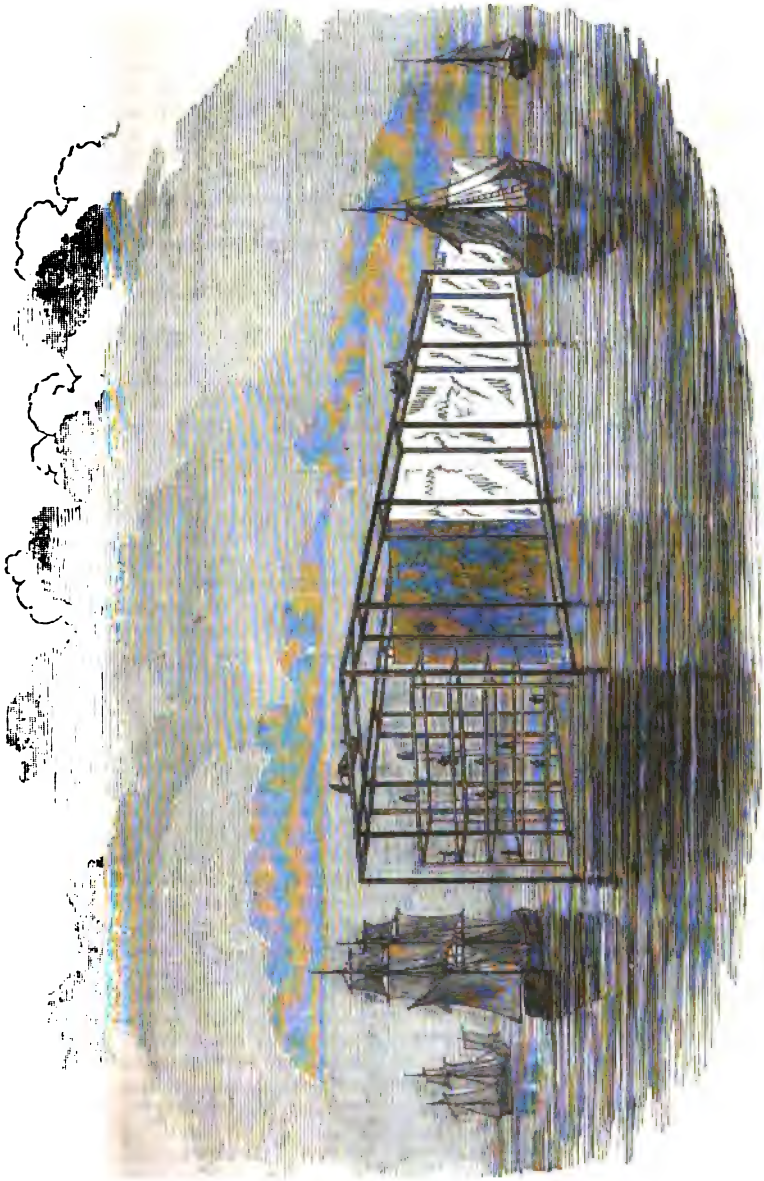
BRUCE'S PATENT METHOD OF CONSTRUCTING PIERS AND BREAKWATERS.

Fig. 1.



BRUCE'S PATENT METHOD OF CONSTRUCTING PIERS AND BREAKWATERS.

In March, 1847, a patent was granted to Wm. Bruce, Esq., of the Temple, Barrister-at-law, and of Flimstone, Pembrokeshire, for "certain improvements in constructing piers, breakwaters, and other submarine works of stone." As no account of these improvements has yet been published, and the subject of submarine architecture is now occupying a good deal of attention, in connection with the construction of Harbours of Refuge, perhaps the following outline of Mr. Bruce's plans may not be unacceptable to the numerous engineering readers of the *Mechanics' Magazine*.

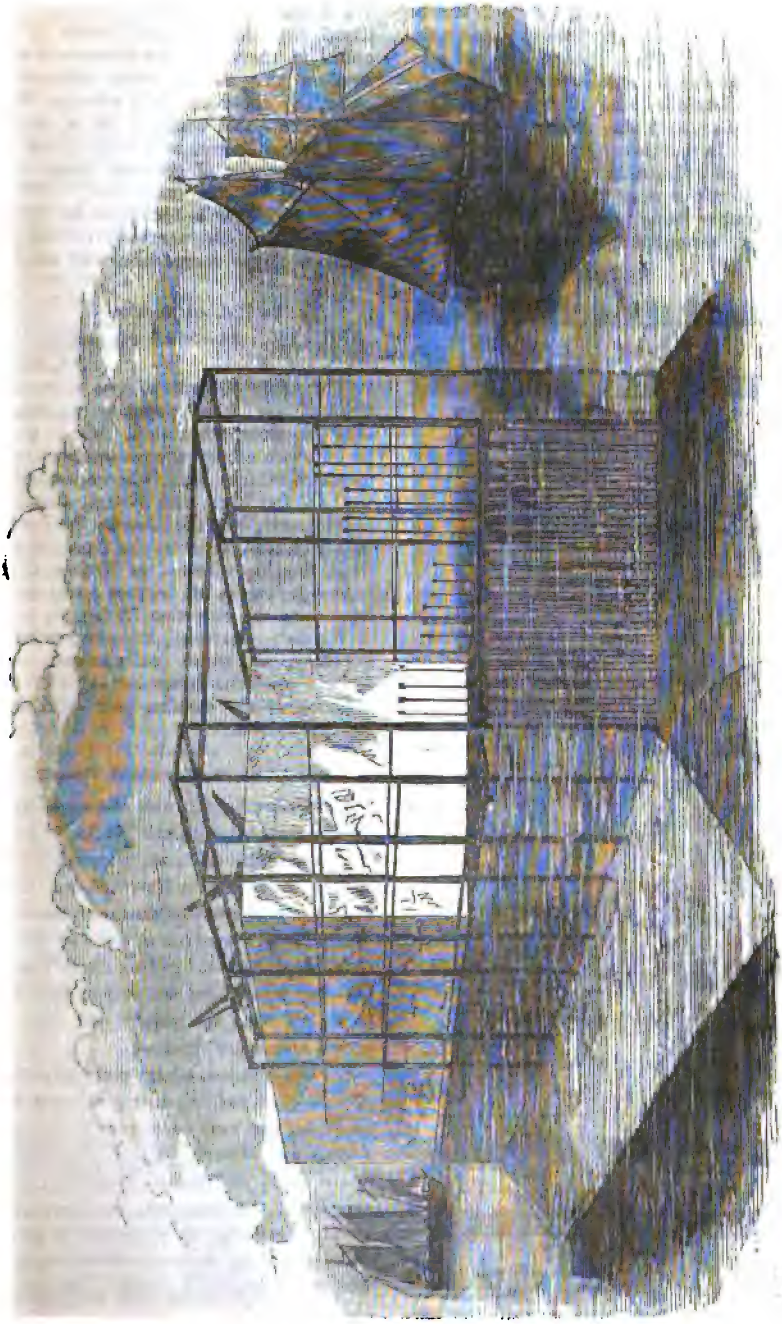
Mr. Bruce had two objects in view; first, building under water by means of machinery; and, second, the application to such structures of the principle of columnar subsidence, so as to supersede the necessity for a solid foundation.

The first of these objects he proposes to attain by a framework of guiding-rods, forty (or more) in number, dropped perpendicularly into the water, and dependent from a framework or traveller (something resembling the Jenny and traveller in ordinary use,) which is to travel on a timber framework or staging on each side of the mole, of the same description as that used in building the palaces at Westminster, Pimlico, and other stone-built edifices. The mole, consequently, is to be built endways by lowering the blocks of stone; the structure commencing from a given pier-head of bell-work masonry, or wooden piles, and being finished to the top before the following series of blocks are lowered down. The stones, deeply grooved, slide down perpendicularly between the finished wall behind and the sort of *pendent gridiron* in front. The weight of the iron work keeps the perpendicular face of the wall in its place, while on every two bars a screw-jack travels up and down, turned by a rod, the head of which is above water, and worked by the workmen from above, so that 20 men, working 20 screw-jacks, screw into their proper places five blocks of grooved stones, to stand in layers upon one another, like the basaltic rocks of the Giant's Causeway, at from 17 or 18 feet below low-water-mark up to the surface, in rows of five stones, but actually representing 14 hexagonal columnar shafts, the axes whereof are cut by the same plane, standing together in four triple hexagonal columnar shafts and one double hexagonal columnar shaft. The result is, that a continuous dovetail, from front to rear, of stones cut with mathematical nicety in hexagonal figures, is produced; and when attained, the second object contemplated by the patentee, namely, the constructing of a mole, or submarine structure of stone, without having recourse to a solid foundation, is also realized, because, as the dovetail is complete from front to rear, these triple columns cannot fall either backwards or forwards. And as the wall must ultimately be ended by pier-heads right and left, and the wall itself is screwed sideways by powerful machinery while building, and the stones are cut of a geometrical figure, which precludes the possibility of any vacancies or particular interstices, these triple hexagonal columns can only be moved upwards to the zenith, or downwards into the sand; and, however soft the sand (unless an actual shaking bog, on which not even a rock itself would find a bed,) the columnar hexagonal shafts will find a bottom to subside upon; and any occasional extra subsidence can be supplied by an additional layer of stones placed on the top, to the extent of the subsidence.

The accompanying sketches will serve to illustrate the mode of construction which has been just described. Figs. 1 and 2 are two different perspective views of a pier in the course of construction, and of the machinery employed; and fig. 3 is a plan of a portion of the work, showing its columnar and Giant-causeway character.

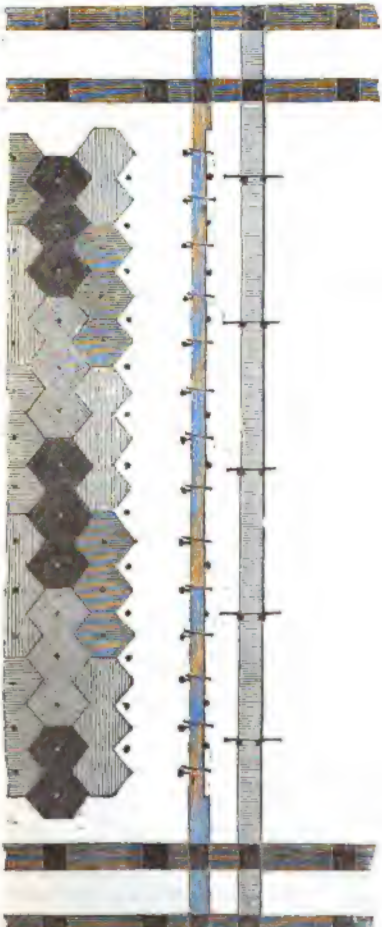
The practical utility of such a patent as we have been describing can hardly be expected to be tested by a private individual, or even a company. It is for the Government engineers or contractors to consider it in an economical point of view, and for the scientific inquirer to investigate its applicability. In the latter point of view it solves the difficulty experienced by architects engaged upon structures under water, of building on sand banks, and converting such roadsteads as Yarmouth Roads, Bridlington Bay, Holliwell Bay, &c., into smooth-water harbours of refuge at the time of high water. With respect to the expense, that must be altogether dependent on local circumstances,

Fig. 2.



and the supply of stone; for instance, where, as at Holyhead, the rocks can be blasted and carried by trams at once to the spot of deposition, there the *pierre perdue* submarine embankment can be deposited at one penny and a decimal per cubic foot, according to Mr. Rendel's estimate. In that case, the expense of deeply grooved or indented ashlar blocks would exceed the expense, taking into calculation the cubic contents and price of the mere rough deposited embankment of *pierre*

Fig. 3.



perdue blocks; but where the same given quantity in cubic contents, would require to be sea-borne, as in the construction of the Dover harbour of refuge, the freight, shipping, and pitching overboard form the principal items in the cost. If, therefore, Mr. Bruce can construct a pier wall in eight fathoms of water, the cubic contents whereof shall be to the cubic contents of a sloping faced embankment, as 1 is to 7, and the cost of his pier of grooved stone shall be 11d. to 12d. per cubic foot, while the cost of the other is 1¼d. plus the freight and shipping (8s. per ton) or 4d. per cubic foot, the comparison will stand as follows:—

as $1 \times 12d. = 12d.$ is to

$7 \times 1\frac{1}{4}d. \times 4d = 35d.$, or a saving of 200 per cent.

The cubic contents of two piers constructed on these opposite principles may be thus contrasted. One would be represented by a cross-section of a tumulus 30 feet high, whereon stands a wall 48 feet high, and 23 feet, 4 inches, in thickness; and the other by the section of a tumulus, which is the frustum of a cone, the top whereof is 70 feet at the least—the angles 40 degrees each at the base—and the elevation 78 feet.

We do not pretend, however, to strict accuracy, as these calculations were formed upon the irregular slope of the sea-face of the eastern pier of Kingstown Breakwater.

THE "SCOTIA" STEAM-VESSEL.

On Wednesday this splendid vessel made an experimental trip from Blackwall round the Mouse Light and back, prior to her leaving the Thames for the Holyhead and Dublin station. It is intended that she shall leave Holyhead on the arrival of the day express train from London, by which means passengers may travel from one city to the other in a day. The sea passage will then not exceed four hours' duration.

On this occasion, a large party of persons of distinction and scientific gentlemen were on board, who were unanimous in the conclusion that Messrs. Wigram, the builders of the vessel, and Messrs. Maudslay, Sons, and Field, the engineers, had been completely successful in producing a steam-vessel, combining at once extraordinary speed with great beauty, steadiness, and convenience.

LONDON FIRES IN 1847.—BY MR. W. BADDELEY, C.E., INVENTOR OF THE FARMER'S FIRE-ENGINE, PORTABLE CANVAS CISTERNS, IMPROVED HOSE-REEL, ENGINE LAMPS, SPREADERS, ETC., ETC.*

" Another year, with mercies strown,
With joys and griefs, has swiftly flown,
And we are still in life's rude tide;
Father, be Thou our constant Guide!

" The statistics of London fires are by no means devoid of interest, and the time may come when they will form an index to the social advancement of the people; for in proportion as houses are built more and more fire-proof, and habits of carefulness become more and more diffused, the number of destructive fires will assuredly lessen."—*Knight's London.*

The year 1847 was marked by a diminution not only in the number, but also in the extent of fires, in the Metropolis. For although a few of these accidents were of a most destructive character, by far the greater number yielded to the prompt application of remedial measures. Two hundred and forty-nine were extinguished by the *inmates;* three hundred and twenty-one by *casual assistants;* while the extinction of two hundred and sixty-six devolved upon the *firemen.*

Subjoined is a tabular view of the periods of their occurrence.

MONTHS.	Number of Fires.	Number of Fatal Fires.	Number of Lives Lost	Alarms from Chimneys on Fire.	False Alarms.
January	81	2	2	9	8
February	60	3	3	10	4
March	58	3	3	4	4
April	72	2	2	13	2
May	72	1	1	1	4
June	64	0	0	2	4
July	82	0	0	3	15
August	68	0	0	3	11
September	70	1	1	3	11
October	64	3	4	7	13
November.....	67	1	1	4	6
December.....	78	1	1	7	6
Total......	836	17	18	66	88

Of these, there were consumed	27
Seriously damaged..	273
Slightly damaged	536
	836
Chimneys on fire	66
False alarms	88
Making the total number of calls	990
The number of instances in which insurances were known to have been effected upon the building and contents, was	263
On the building only.......................................	125
On the contents only.......................................	157
Uninjured	291
	836

From these returns, it will be seen how large a number of persons neglect to avail themselves of the benefits of insurance, and even of those who are

"* Mr. Baddeley begs to apologize to the Editor and to his readers for the late period of the year to which his *fire report* has been delayed. Severe domestic bereavements, followed by illness and great mental prostration, have prevented the completion of the necessary analysis till the present time.

" Notwithstanding the difficulties he has to contend with in procuring particulars, the writer trusts that if spared till 1849, his Report will be forthcoming at the usual period.

" 29, Alfred-street, Islington,
June, 30, 1488."

insured, the greater majority are only *partially* so. A recent writer very justly observes on this head—

"We had thought that, as insurance against fire was now ranked amongst the social duties, that few would be found who hesitated or neglected to avail themselves of its advantages. But these returns undeceive us, and forcibly show how easy it is to give the public undeserved credit for prudence and economy. If the returns be any criterion by which to judge of the insurance state of property, there must be fully one-third of the dwellings of the metropolis and their contents unprotected by the readiest, most secure, and most economical means that have yet, or ever will be, devised for obtaining security from loss by fire. Several statisticians have estimated the amount of uninsured property in the metropolis at a higher rate than one-third; but, taking that as a correct proportion, what an astounding risk is run by the owners of such dwellings and chattels; a risk, too, perfectly gratuitous—for the expense of insuring is a mere trifle, and, we feel convinced, is not *the* deterring cause. It is rather a culpable carelessness, which shuts its eyes to the possibility of loss, and relies for security on the chapter of accidents. And a pretty chapter it appears when attentively read. The fire returns for London are a good commentary upon the text it furnishes; for those returns show that the majority of fires in dwelling-houses are caused by the simplest of agencies. Every year we record a number of these casualties originated by a spark from a candle, a spark from the fire, an escape of gas, foul flues, and sundry other trivial, but every-day occurring and property-jeopardizing accidents. We might adduce many apparently slight causes of fire, but the wiser course would appear to be, for everybody to treat even the most trivial agent in producing that calamity as anything but insignificant, and to be prepared, by assurance, for every contingency and emergency of the kind. The utmost individual precaution has been, over and over again, found to be utterly ineffectual as a preventive of fire; and if we look at the number and variety of the causes, the opposite result would appear almost an impossibility. Therefore, it is a duty incumbent on every possessor of property that he safely and regularly keep himself insured from loss by fire. Self-respect and consideration for others assist in improving the obligation, every idea of moral and social duty adds to its strength, and the man who fails in his respect for it is an enemy to himself, and unfitted by his improvidence to be an equitable administrator of the property confided to his care. The 'uninsured man' loses credit and estimation; he is universally distrusted, and deservedly so—for he is a wilful provoker of misfortune; a man whose means of living, be they good or indifferent, depend for continuance upon chance. To-day he may riot in fancied security, and before the dawn of another day be a beggar. Experience fully demonstrates that such men are, with few exceptions, victims to their own folly; for although the danger they court and tempt to do its worst upon them, may not be the actual cause of their downfall, yet such gross indiscretion engenders other pernicious habits, and sooner or later, the retribution comes, and generally with terrible force. The vulgar and the stupid, class such unfortunates among the 'unlucky,' but we have yet to learn that an improvident, reckless, and silly man can justly lay all his distress at the door of fortune. The fickle dame, undoubtedly, plays a great part in the drama of life, but there are occasions and opportunities when she may be disarmed of her dreaded power, and be a thing of the imagination, before industry, economy, and sagacity."

The loss of life which, although greatly diminished, still appears to be large, is resolvable into the following classification:

Personal accidents, from falls, &c.	4
————, from ignition of apparel on the person	4
————, from intoxication...	2
————, from ignition of bedding............	2
————, from reading in bed	1
————, from explosion of fireworks........	3
From *inability to escape* from burning buildings	2
	18

From this statement it will be evident that a wonderful and gratifying improvement has been effected in the Metropolis, by the Royal Society for the Protection of Life from Fire, both as regards the number of lives saved solely by their servants, and also by the confidence they have established in the public mind leading indirectly to the very best results.

The following fires are deserving of special notice:

Wednesday, February 17, 10½ P.M. A fire broke out on the premises of Mr. W. Grover, boot and shoe maker, High-street, Brentford, which, but for the courageous exertions of two youths (George Best and Henry Taylor) would have been attended with a most lamentable loss of life. On the first alarm,

Best, who resided next door, attempted to arouse the inmates by violently knocking at the street door, but failing to do so, he returned to the back of the building, and after climbing the wall, succeeded, with the aid of a poleaxe in breaking open the back door, when he ascended the staircase and made for Mr. Grover's bedroom; the smoke and sparks were at the same time rushing upwards with the greatest velocity; after considerable trouble he entered the bedchamber, but the smoke had obtained such power over the inmates that they were perfectly unconscious of what was going on. Best having violently shaken Mr. Grover, took two of his children in his arms and brought them down stairs, where he passed them through the window to the police, who placed them in safety; he again ascended, and with Taylor's assistance, saved Mr. Grover and his wife and a third child in a similar manner. Not feeling then satisfied that all were saved, Best returned into the burning premises a third time, and inspected every room not on fire, and being convinced that all the inmates were got out, he was about to run down the stairs to escape himself, when a large sheet of flame overtook him on the staircase and completely knocked him down; but having recovered himself, he opened one of the back windows and leaped into the yard; when picked up he was quite insensible, and the blood issuing from his nose and mouth, so powerful and suffocating an effect had the smoke upon him, and it was some time before he could be restored.

The prompt arrival of the neighbouring parish engines, aided by those of the Brigade, County, and West of England from town, prevented the fire extending beyond Mr. Grover's premises.

At the Annual Meeting of the *Royal Society for the Protection of Life from Fire*, the Society's silver medal and a sovereign were presented to George Best, and the Society's silver medal to Henry Taylor.

Monday, March 1, 2¾ P.M. A fire broke out in the roof of the Fever Hospital at Battle Bridge, owing to a defect in the flue. The police apprehensive of personal danger to the inmates, went to the residence of *Conductor Hill* and requested his attendance with the Royal Society's Fire-escape. Hill immediately arose from his bed and proceeded with his machine to the scene of danger. In descending from the top of the building, Hill either grasped the slack rope, or the rope was jerked out of the hands of some person below, and Hill fell heavily to the ground, breaking his knee cap; he was removed to St. Bartholomew's Hospital, from whence he was ejected before cured, and as it afterwards proved, while labouring under a rupture of the diaphragm, of which he soon after died.

Tuesday, March 9, 6¾ P.M. A fire broke out in the house of Mr. Lavell, No. 26, Brownlow-street, Drury-lane. The progress of the flames was so rapid as completely to cut off the escape of a female (Mrs. Warren) lodging in the third floor, who, after an ineffectual attempt to escape by the stairs, retreated to the window to save herself from suffocation; it was then only that her danger was known, for so sudden had been the fire as to take every one by surprise, that had it not been for the foresight and presence of mind of Mr. Hemming, a plumber and glazier, living opposite, no means would have been at hand to rescue her. Mr. Hemming, upon the first alarm of fire, obtained the assistance of one or two persons to get from his premises a second-floor ladder, thinking it would be useful, and by the time it was brought into the street the poor woman was actually hanging by her hands from the window-sill at a height of nearly 40 feet; the ladder was then quickly raised, and before it could be fixed against the house, John Daly, a man in the service of Messrs. Combe and Co., rushed up; finding the ladder some feet too short, he stood on the highest rail he could, and catching hold of the poor woman, slipped her down his arm and brought her to the ground in safety, amidst the cheers of the bystanders. Great strength appears to have been used by Daly, and considerable risk incurred from the ladder being too short.

The Royal Society's silver medal was presented to Daly, and a testimonial on vellum to Mr. Hemming.

Sunday, March 14, ½ A.M. A most terrific conflagration broke out in the extensive tar-works and saw-mills of Mr. Bethell, in Battersea-fields. The works occupied a large area of ground, covered with piles of the most inflammable materials. The awful appearance of the fire soon drew a strong attendance of firemen and engines to the spot; but they were powerless for want of water. Mr. Henderson (the district foreman) had commenced forming a chain of engines from the reservoirs of the Southwark Water Company; but met with a ditch midway, from whence he commenced working. In the meantime, a sufficient number of hands being collected, they began to clear away the piles of timber on the adjoining premises, so as to make a roadway to the waterside, under the active superintendence of Mr. Robins (formerly of the Norwich Union.) This being done, an inclined plane was formed from the top of the jetty on to the beach, when the Brigade engine from Farringdon-street, the County, and the West of England were skilfully lowered, and in full operation in a few minutes; and, by their united power, the progress which the flames were rapidly making in an easterly direction, was happily arrested. But for this admirable movement, the destruction of several barges and steamboats lying aground was inevitable, as was also the timber-yards, whiting manufactories, &c., in close proximity. The large quantity of unextinguishable inflammable matter upon which the flames were preying, caused the heavens to be illumined till daylight, and the fire continued to burn for hours afterwards. Every possible exertion was made by all present, and the conduct of the firemen was beyond all praise.

A grossly-perverted statement of facts connected with this fire appeared in the *Times*, evidently proceeding from some one imbued with hostile feelings towards the firemen, and entirely ignorant of the difficulties they had to contend with upon this occasion.

The property destroyed consisted of the engine-house, rectifying-house, saw-mills, and about 14,000 railway sleepers. The still-house was also seriously damaged; one barge was entirely destroyed, and two were seriously damaged, as were also some of the adjoining properties.

Wednesday, March 31, 6¾ P.M. A fire broke out at No. 2, Little Denmark-street, St. Giles's, originating in a foul flue. The Crown-street Brigade engines were promptly on the spot, and *Benjamin Cumming*, fireman No. 30, having ascended the roof, the ladder on which he was standing gave way, and he was precipitated into the street, receiving such severe injuries that he expired shortly after.

Monday, April 5, 3¼ A.M. A policeman on London Bridge perceived smoke rising, which he traced to come from the Kent and Essex Wharf, Montague Close, Southwark. An alarm was immediately given, and numerous engines from the Brigade, West of England, and County stations reached the spot before the fire manifested itself. Immense volumes of smoke arose from the warehouse, and at length the flames burst forth from every opening.

The supply of water was scanty, that of hands still more so, and the fire raged for some time with a fury that seemed to defy opposition. In a short time, however, it began to yield to the powerful efforts that were making for its suppression, and was ultimately extinguished without spreading beyond the building in which it commenced; this building and its contents were, however, nearly destroyed.

A court of inquiry as to the origin of this fire was held by Mr. W. Payne, the City Coroner, when the following verdict was returned:—"That there is not sufficient evidence to enable the jury to decide how the fire originated; but, in their opinion, there is every probability that it arose from the spontaneous combustion of some bales of waste or shoddy."

Thursday, April 29, 8½ P.M. A fire broke out in the shop of Mr. Raphael Moritz, dealer in embroidery and Berlin wool, 130, New Bond-street. Mr. Staples (district foreman) with the Brigade engine, from King-street, was on the spot in a few minutes, broke open the door, and extinguished the fire.

Mr. Moritz was insured in the *Defender* office for 800*l*., and he claimed 680*l*. for the property destroyed at the above fire, which took place in a shop 15 feet long by 9 feet wide, and did not burn a quarter of an hour. Mr. Moritz (who is a Prussian Jew) brought an action against the office, which was tried at Hertford, July 10, 1847. Before hearing any evidence for the *defence*, the jury interfered and said, "They were not satisfied that the fire was not *wilful*; and with regard to the amount of the claims, they did not believe that any such amount of property was in the shop at the time of the fire." Evidence for the defendants (who pleaded that the fire had been wilfully occasioned, and that the defendant's claim was fradulent) was however gone into, when the case became so bad that Serjeant Shee (for the plaintiff) said, "That, rather than a verdict for the defendant should be returned, he would withdraw from the case." The plaintiff was accordingly *nonsuited*.

Saturday, June 5, 1 A.M. A most alarming fire burst forth from one of the workshops of Messrs. Maudslay, Sons, and Field, Westminster-road. The flames commenced in a new building at the end of an extensive range of workshops, composed for the most part of timber, and the flames spread with such rapidity, that in a few minutes several parts of the premises were in flames. The West of England engine being run into the premises, was set to work from the mains belonging to the factory. The Brigade and County engines arrived from the various stations, and placed themselves in the best positions from whence water could be obtained; unfortunately, however, the supply of this element was wholly inadequate to the emergency, and the scanty supply that was obtained was at a considerable distance from the fire. For some time the efforts of the firemen were of little avail; and from the carpenters' shops the fire extended to the boiler-makers', and from thence to the pattern lofts and spacious foundry. At two o'clock the metropolis was brilliantly illuminated by the flames for miles round. The most heroic efforts were made by the firemen, under Mr. Braidwood, by those of the West of England, under Mr. Connerton, and the County, under Mr. Garwood, with the best results, and by six o'clock all danger of further extension was at an end. The pattern makers', boiler makers', carpenters' shops, about half the pattern loft, and foundry were destroyed. One vice and and finishing shop, the smiths' shop, and the new buildings were severely damaged.

The origin of the fire remains unknown.

Wednesday, June 7, 2 A.M. During a violent thunder storm, the electric fluid struck the house of Mr. Wiseman, Brewer's-lane, Greenwich, the roof of which was instantly in flames; the neighbourhood was speedily roused, and a scene of great confusion ensued as the fire flew from house to house with great rapidity. The buildings were very old, and mostly composed of timber. The engines from Greenwich Hospital, one of the Brigade from town, as well as the County and West of England, were in attendance as promptly as possible. The floating engine, from Deptford dockyard, was also brought to the spot, and every effort was made to arrest the progress of the flames; but before this could be effected, nine houses had been entirely destroyed, and several others more or less injured.

The electric fluid also at the same time fired the house of Mr. Wichelow, Paulin-street, Bermondsey, and the flames were not extinguished until they had done considerable injury.

Saturday, July 31, 1 A.M. A fire broke out in the shop of Mr. Wise, saddler and harness maker, No. 2, West Smithfield, at which time Mr. Wise and his son were sleeping in a room behind the shop. In the first-floor back room slept Mr. Mead, his wife, and two children, three older children sleeping in the room over them. A German, named Myrck, also slept on that floor, while another German, named Casler, slept in a middle room on the third story, and he was the first discoverer of the fire; finding his room full of smoke, he ran down stairs, and alarmed Mr. Myrck, who descended to the first floor, and roused Mr. Mead. The latter ran up stairs to his children, but they had locked themselves in, and mislaid the key; eventually, however, they opened the door, and were taken by their father into the first-floor front room just as the flames ascended the staircase. Mr. Mead and the whole of his family (seven persons) escaped safely from the window, being received in a jumping-sheet from the police station adjoining. Mr. Wise and his son escaped at the back of the premises into an adjoining house, while the two Germans got on to the roof, where they preferred to remain until the fire was extinguished. The fire commenced in a corner on the left-hand side of the shop, from whence it extended through the partition to the staircase, the draught of which caused it to burn most fiercely. The prompt arrival of the engines from the Farringdon-street and other stations, with a good supply of water most skilfully applied, happily soon arrested the progress of the flames.

The origin of this fire appearing to be inexplicable, Mr. Payne, the City Coroner, held a court of inquiry into the cause on the following Monday, when the preceding facts were given in evidence, as also that Mr. Wise reached home about 11 o'clock on the Saturday night previous to the fire, and, lighting a candle, passed through the shop to his sleeping apartment with his son, when all appeared safe. At the conclusion of the evidence, Mr. Payne observed, "That there was not the slightest reason to suppose that the fire had been wilfully kindled—placing, as it did, the lives of all the inhabitants in such imminent peril—but, that there was no

positive evidence to show how the fire originated;" and the jury returned a verdict to that effect. It was generally supposed, however, that Mr. Wise's unextinguished match had fallen upon some soft combustible, which mouldered on till 1 o'clock, when it burst into a flame, and the work of destruction commenced.

Saturday, August 14, 11¾ P.M. A fire broke out at No. 2, Great Barlow-street, Marylebone. When first discovered, the fire was raging on the first-floor, from whence the flames extended to the staircase, cutting off the communication. The second floor was occupied by Mrs. Compton and four daughters (one paralytic) who, on the alarm being given, presented themselves at the window, imploring help. No means of rescue appearing to be at hand, the crowd called to the mother to throw herself and children out of the window; happily, however, she had too little nerve, or too much good sense, to embrace so hastily this rash expedient; and, in a very few minutes, *Conductor Hutchings*, with the Royal Society's fire-escape, from the King-street station, arrived on the spot, and placing his escape against the burning building, brought the whole family down in safety, amid the plaudits of the gratified spectators. The fire was promptly extinguished by the parish and Brigade engines, the first and second floor being burned out, and the staircase seriously damaged.

The Royal Society presented Hutchings with their silver medal for his prompt attendance and meritorious exertions: they also gave the sum of 1*l.*, and a certificate on vellum, to Mary Cromer, a domestic servant, who rushed into the burning room at the same fire, and rescued a little child at the risk of her life, her own night dress and hair being ignited in the act.

Thursday, August 26, 3½ A.M. A fire broke out at No. 36, Beech-street, Barbican, in the portion of the shop occupied by a Mr. Leopold Hail. The fire spread rapidly into the part occupied by Mr. Jones, an eating-house keeper, and also to Mr. Ingram's timber-yard; and, notwithstanding the prompt attendance of a strong body of firemen and engines, was extinguished with considerable difficulty.

In consequence of many suspicious circumstances attending the outbreak of this fire, Mr. Payne held a court of inquiry, in the course of which the wilful origin of the fire was so apparent, and the claim made upon the Sun Fire Office so manifestly fraudulent, that the jury returned a verdict—"That the house was wilfully set on fire by the tenant, Leopold Hail;" and the coroner made out a warrant for his committal to Newgate; but he subsequently got liberated on bail, when, in addition, he gave "leg bail," and so escaped the consequences of his diabolical crime.

Sunday, September 26, 2¾ A.M. A fire broke out at No. 17, Lower Seymour-street, Portman-square, in the sleeping room of Mrs. Anna Jane Pochin (aged 63) who had long been in the constant habit of reading in bed. Her maid being roused by the ringing of her bell, hastened to answer it, when she found Mrs. Pochin's room on fire, but was unable to enter, the door being bolted inside. An alarm of fire was given, and *Conductor Brown*, with the Royal Society's fire-escape, was in immediate attendance. Having forced an entrance to the room, he courageously dashed through the flames, and brought out Mrs. Pochin, who was promply attended by a neighbouring surgeon, but unfortunately she had received such severe injuries, that she expired in 32 hours after the accident. The fire was extinguished before it spread beyond the room in which it so unfortunately commenced.

At the inquest, Mr. Wakley, the coroner, commented on the danger of reading in bed, particularly on the part of aged and feeble persons, and said, "the practice was invariably attended, sooner or later, by fatal consequences." The jury returned a verdict of "accidental death," accompanied by an encomium on the gallant conduct of fire-escape conductor Brown, to whom the Royal Society presented their silver medal for his praiseworthy exertions.

Monday, Oct. 11, 7 P.M. A fire attended with loss of life occurred on the premises of Mr. Whitaker, furniture dealer, No. 28, Water-lane, Blackfriars. The flames were first seen burning in Mr. Whitaker's shop (which was closed) by a police-constable, who immediately alarmed the occupants of the upper part of the house, which consisted of Mrs. Hamilton and family, and a maiden lady named Purday, aged 60. On the alarm of fire being given, Mrs. Hamilton escaped down stairs with her children; on the staircase she saw Miss Purday, and told her "to go down, as the house was on fire," and supposed she did so. Mrs. Hamilton went up stairs again to rescue some papers and returned in safety. The fire raged furiously, until the prompt attendance of the firemen with a plentiful supply of water arrested its progress. After the fire was extinguished, the firemen were surprised at finding the dead body of Miss Purday on the third floor, about four feet from the window. As no person knew that any one remained in the premises, no effort was made to rescue the deceased.

The police were in attendance with their jumping-sheet, but as that does not afford the means of ascending, no search could be made, and the fire happened an hour before the Royal Society's escapes are on duty. Their conductors *invariably ascend and search the premises* to guard against such calamities as the present. An inquest was held before Mr. Payne, when the jury returned a verdict, "that the deceased was burned to death in a fire which occurred in the premises of Mr. Whitaker; but how the fire took place there was not sufficient evidence to prove." The foreman tendered the thanks of the jury "to the whole of the firemen and police for their extraordinary exertions on the night in question." It subsequently appeared that Mr. Whitaker quitted his shop a few minutes before seven, turning down the gas-burners very low; it would seem that in shutting the door he blew out the light in the shop, and the gas escaped until a large quantity became collected and ignited at the other burner, when the work of destruction went on.

Thursday, Oct. 28, 2¼ A.M. A fire was discovered in the house, No. 2, Drummond-street, Euston-square, which proved fatal to one of the inmates. The fire began in the shop of Mr. Lawson, stationer,

and on being roused the inmates ran down stairs into the street, with the exception of a Mrs. Mackie, who, apparently paralysed by fear, fell down on the landing, and before her distressing situation was known, was enveloped by the ascending flames and burned to death. The parish engine, and one from the adjoining railway station, were brought out, but for want of some person skilled in their use, were of little avail. The Brigade engines and firemen soon reached the spot, and by their exertions extinguished the fire. The shop, first and second floor, were burned out, and the roof destroyed, and two adjoining premises slightly damaged.

Monday, November 29, 4¾ P. M. A most destructive conflagration broke out in the workshops* of Messrs. Lawrence and Sons, carpenters and builders, Pitfield-street, Hoxton. From the inflammable contents of the premises, the flames spread rapidly, and soon ignited several houses in Queen-street, three of which were completely destroyed and several others seriously damaged before any force of engines or water could be brought to bear upon them. At the same time the fire spread from one stack of timber to another, until the whole was one burning mass, throwing out a glowing heat which defied approach, and the light of which illuminated the metropolis for hours, and caused the greatest consternation to prevail in this densely crowded neighbourhood. By eleven o'clock all danger of further extension was at an end, and the firemen by great exertion preserved the dwelling house unscathed.

Monday, December 6, 9¾ A. M. A fire took place in the shop of Mr. Bowry, oil and colourman, 54, Fetter-lane, owing to a leak in the turpentine cistern, the vapour of which ignited on the approach of the shopman with a lighted candle. A cry of "fire" was instantly raised, and Mr. Bowry, who was in one of the upper rooms, finding the smoke coming up stairs, opened his bed-room window and jumped into the street, by which his thigh was broken and he was otherwise so much injured that he expired four days afterwards in St. Bartholomew's Hospital. By the prompt attendance of the firemen, the fire was speedily extinguished with but slight damage to the shop and its dangerous contents.

The following list shows the occupancy of the premises, with reference to that portion of them in which the fire originated, thereby illustrating the comparative liability to accident by fire of various trades and manufactures, as compared with private dwellings.

Anchor smith	1
Bakers	25
Barges	2
Basket maker	1
Beer shops	6
Bleacher, willow	1
Boat builders	2
Bonnet-shape makers	1
Booksellers, binders and stationers	14
Boot and shoe makers	6
Box makers, fancy	1
Brewer	1
Brokers, furniture	6
Brush makers	2
Cabinet makers and upholsterers	16
Carpenters and builders	25
Cart	1
Chair makers	3
Chapels and Churches	3
Charcoal makers	2
Cheesemongers	4
Chemist	1
Chemical laboratories	2
Coach makers	2
Coals, dealers in	4
Coffee shops and eating houses	5
Confectioners	4
Coopers	2
Cutlers	1
College	1
Distillers	2
Dwellings, private	348
Dyers	1
Engineers	7
Farming stock	8
Feather dressers and bedding manufacturers	4
Fellmongers	2
Fireworks, makers of	3
———, dealers in	2
Flax dressers	2
Founders, iron	2
Fringe maker	1
Furriers	3
Gas works	1
General dealers	13
Glass works	1
—— cutters	1
—— paper makers	1
Grocers	6
Greengrocers	4
Haberdashers, milliners & dressmakers	9
Hatters and hat manufacturers	7
Harness makers	4
Hay salesmen	3
Heel ball manufacturer	1
Hosiers	6
Hospital	1
Hotels, taverns and club-houses	9
Ironmongers	3
Japanners	1
Laundresses	3
Leather dressers	2
Lime shed	1
—— barge	1
Linendrapers	7
Lucifer match makers	5
————————, dealers in	2
Lunatic asylum	1
Maltster	1
Marine stores, dealers in	3
Meat curer	1
Musical instrument makers	4
Oil refiner	1
— and colourmen	14
Organ builder	1
Paper stainer	1

* The fire commenced in a portion of the workshops which had only just been reinstated after being destroyed by fire on the 18th of October preceding.

Picture frame and looking-glass makers	3
Pipe makers	2
Printers	6
——— steam	2
Public buildings	2
Rag merchant	1
Railway stores	2
Refiners	1
Rope makers	2
Sash maker	1
Sale shops and offices	37
Saw mills	2
Ships	3
——, steam	2
——, builders	1
——, chandlers	1
Slaughter house	1
Soot merchant	1
Splint cutter	1
Stables	20
Straw bonnet manufacturers	2
Sugar refiner	1
Tailors	8
Tallow chandlers	2
——— melters	2
Tanners	1
Theatres	2
Timber merchants	1
Tinmen, braziers, and coppersmiths	3
Tobacco and snuff manufacturers	4
Tobacconists	2
Turners and workers in wood not carpenters	8
Victuallers, licensed	27
Unfinished buildings, and under repair	5
Unoccupied	6
Wadding manufacturer	1
Warehouses	5
———, Manchester	1
Wharfs	5
Wheelwrights	3
Wine merchants	7
Total	836

The causes of fire, so far as they could be satisfactorily ascertained, appear to have been as follows:—

Accidents of various kinds, for the most part unavoidable	14
Apparel ignited on the person	3
Bleaching nuts, &c., with sulphur	3
Candles, various accidents with	115
———, ignited bed curtains	64
———, window curtains	58
Carelessness, palpable instances of	19
Charcoal fires	5
Children playing with fire	8
——————— candles	2
——————— lucifer matches	6
Cinders put away hot	9
Coppers improperly set	3
Drunkenness	5
Fire sparks	63
——— from locomotive engines	2
Fireworks, making	3
———, selling	2
———, letting off	1
Fires kindled on hearths and other improper places	3
Flues, overheated and defective	89
——, foul and ignited	22
——, blocked up	7
—— in adjoining house	10
Fumigation, incautious	4
Furnaces overheated, &c.	13
Gas, accidents in lighting	6
——, escape of, from defective fittings	41
——————— street mains	3
—— left burning	9
—— fittings, carelessness in repairing	3
—— chimney, heat of	1
Gunpowder, explosion of	2
Hearths, defective	8
Kiln, overheated	1
Lamps, oil and naphtha, one each	2
Lightning	2
Lime, slaking of	5
Linen, drying before fires	34
Lucifer matches, making of	3
———————, using	6
Naphtha, vapour of ignited	4
Ovens, defective and overheated	8
Pitch, tar, and tallow, boiling of	4
Reading in bed	1
Shavings, loose, ignited	37
Spontaneous ignition of charcoal	1
——————— coals	2
——————— dung	2
——————— flax	1
——————— hay	1
——————— lucifers, by sun's heat	2
——————— lucifers by friction in drawer	1
——————— lamp black	1
——————— rags, wet	3
——————— shoddy	1
Stoves, defective and overheated	15
——, improperly set	7
——, drying, overheated	4
——, pipe	8
Steam boilers, heat of	4
Smoking meat	1
Suspicious	17
Tobacco smoking	18
Wilful	17
	764
Unknown	72
Total	836

The daily distribution of these fires has been as follows:

Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.	Sunday.
127	101	133	119	129	111	116

Their distribution throughout the day and night has been in the following proportions:

	First hour.	Second hour.	Third hour.	Fourth hour.	Fifth hour.	Sixth hour.	Seventh hour.	Eighth hour.	Ninth hour.	Tenth hour.	Eleventh hour.	Twelfth hour.
A.M.	54	44	37	42	28	19	15	12	14	17	22	29
P M.	22	26	15	20	33	34	45	52	68	63	65	60

The causes of fires will be seen to be of the usual varied character, and a considerable number, notwithstanding the best intentions of all parties to elucidate them, remain enveloped in impenetrable mystery. The following extract from a communication to the *Assurance Gazette* elucidates a piece of carelessness which may in other cases have led to serious mischief.

"Last evening, Sunday, just as I and my family were retiring to bed, we were alarmed by the smell of something burning. For a long time, although we instituted an active search, we could not discover the cause of the fire. Every nook and cranny was examined from the kitchen to the attics, but although the smell increased we were puzzled and baffled, and began to entertain the strongest apprehensions of danger. At last, upon opening a small closet in the kitchen, we discovered some linen and pieces of old cotton smouldering, and about a pound of kitchen candles with the wicks burning, although not in a flame. It appears that the servant in getting a candle to go to bed by, instead of cutting one, *burnt it off the string* that tied the whole together, and then threw the bundle carelessly into the closet. Had we gone to bed without discovering the fire the consequences might have been calamitous; as it was, the accident created a good deal of alarm amongst my family; and I mention the circumstance as an instance of what dreadful consequences might arise, and I am sure do arise, from trivial causes."

Spontaneous combustion has in several instances been traced to its source, and this subject continues to excite much interest among scientific men in all parts of the world.

"A fire was nearly taking place in the arsenal of Fort William, Bengal, a short time since, by a quantity of wax cloth becoming impregnated with linseed oil; the consequence was partial combustion. The first idea of the officials was that the ignition was the work of incendiaries, but the officer in charge, entertaining a suspicion of the true cause, tried the experiment of soaking some of the identical wax-cloth in the identical oil, and placing it afterwards in a box, locked, and under guard. The next morning it was found that the suspicion was a correct one, for the cloth was partially charred, and at a high temperature in its inner folds, the outer being comparatively untouched. Specimens were sent to the Asiatic Society, and exhibited at its last meeting; the secretary, Dr. O'Shaughnessy, in commenting upon the circumstances, stated the singular fact *that if one per cent. of any animal oil, such as neat's-foot oil, were mixed with the linseed or drying oil, it would effectually deprive the latter of its incendiary capabilities.* Captain Biden, the Master Attendant of Madras, has published a long list of vessels in which fires have occurred in Indian ports, and in the cargo of most, the presence of flax and linseed oil is prominent."

During the year 1847, the number of fires on ship-board, from the spontaneous ignition of the cargo, and especially of coals, has increased to a most alarming extent, and calls loudly for a suitable remedy. Several plans, have, indeed, been suggested for this purpose, but none of them of such a practical character as to meet the peculiar difficulties of the case. The following remarks upon this subject, from the *Assurance Gazette*, are deserving of an attentive perusal:—

"A difficult question connected with fires is, to ascertain their cause. The origin of many, perhaps most, of the great conflagrations which have occurred during the last few years, has never been satisfactorily explained. Hence there has frequently been fears excited, and suspicions entertained, where there existed no sufficient reason for either; whilst the very circumstance that nothing really was known, has given occasion to a feeling of habitual distrust and alarm.

"If it be difficult to understand the origin of fires on land, it is still more so of those which happen at sea. Numerous have been the instances in which a ship and her cargo have been consumed, and it has been impossible, on any ordinary principles, even to guess at the cause.

"It cannot be doubted that one of the commonest, and consequently the most frequent, causes of fire at sea, is the spontaneous combustion of the cargo. On board steam-vessels, the ignition of the coal is also a frequent occurrence. The wonder is, not that such accidents occasionally happen, but that they are not more frequent. So also with respect to the cargoes of ships freighted from China, India, and America; when we think of the quantities, the properties, and the methods of stowing of the merchandise brought from these countries respectively, can it be matter of surprise that, by natural processes, under the particular circumstances in which the goods are placed, there should be great risk of fire? The loss by fire of ships freighted with cotton and other products of India, has lately excited great anxiety in that country, and has been the subject of judicial investigation. The only means of preventing such disasters is, to adopt more efficient precautionary measures, and which should have special reference to the qualities and condition of the goods. No one practically acquainted with agriculture will doubt that if hay or corn be stacked in a damp or unripe condition, it will heat, and if it do not take fire (which is frequently the case,) it will be entirely spoiled. This is just as simple and as natural a process as that by which heat is generated in manure, and which is one means of hastening its decomposition. Exactly in the same way that moisture and exclusion from air cause the overheating of hay, and corn, and manure, other vegetable substances are operated on by oil, tallow, and similar materials; and the more readily when subjected to compression and excluded from fresh air.

"Minerals are acted upon by moisture and exclusion from air in the same manner as vegetables. In this case, however, we are accustomed to view the process as being more decidedly chemical in its character. But it is not so. Chemical agencies are at work in the vegetable as well as in the mineral. In the latter, the properties are easier understood, because more distinctly developed, and the energies may be more active, and brought more readily into operation, but the analogy still holds good, although the intermediate steps or the final results may not be identical.

"The cause of fires on board steam-vessels and other ships laden with coal, is perfectly explicable; spontaneous combustion being the ordinary effect of the chemical decomposition of pyrites, and which is promoted by access of moisture. Whatever may be the conditions imposed upon those who supply coal for steam purposes, and however great the caution that may be exercised in selecting it, there always exists a certain quantity of pyrites mixed with the coal, the dangerous properties of which are increased if it be not shipped or stored perfectly dry.

"As philosophical facts, it has long been known that vegetable fibres in common use, as cotton, flax, hemp, &c., are readily acted upon, so as to produce heat, by oils, and resins, and acids; so also is it just as well known that pyrites, which abound in some kinds of coal, are decomposed by water, with evolution of heat sufficient to produce ignition, even when exposed to the atmosphere.

"But notwithstanding our knowledge of these things, what has been done to prevent accidents?

"In factories, engine-rooms, painters' shops, candle manufactories, and on board ships laden with cotton, oil, turpentine, and similar substances, is cleanliness enforced? Are oiled or greasy fragments of cotton, and tow, and yarn, carefully gathered up? Are there no dark corners in which the sweepings of floors, or the cleansings of machinery, are deposited? If these, and many similar questions, cannot be answered promptly and satisfactorily, let it be remembered that the elements of combustion are as certainly at work, and the danger from them is just as imminent as from the carelessness of servants, the over-heating of flues, or the scattering of sparks from fires or candles."

On Sunday, October 24, 8½ P.M., a most brilliant appearance of the *Aurora Borealis* caused for a short time a general alarm of fire; the appearance of a part of the heavens as seen from a confined situation presenting the exact appearance of a terrific conflagration. The first symptoms of this periodical visitant of this hemisphere were perceived about

half-past six in the evening, which gradually increased till 9′ 55″ P.M., when the appearance for nearly an hour was truly magnificent. The rays which had at first a silvery hue now turned to deep crimson, and gradually disappeared. Towards midnight this appearance revived with great splendour, and traces of the Aurora, though faint, existed till after two o'clock on Monday morning:

It was a holy Sabbath night,
The gale blew clear and high,
When, lo! a glory of God's light
Shone up athwart the sky.

A faint thin vapour—misty, dim,
First to the gaze was given,
That rose from the horizon's rim
To topmast vault of Heaven!

More and more glory, grandly now
Upon the vision came;
The column wore a godlike brow,
And took the hue of flame!

While from the arch that curved in sight
Where round the masses grew,
There shot quick streams of silver light
Far—far into the blue!

Then where the flame with crimson hue
Had made its glowing bed,
The stars in burning groups shone through,
And gleamed behind the red.

Still round and round, the streamers bright,
Would flit in many a form,
Till the flame-pillar lost its light
And took the dark of storm!

One moment more, and as a cloud
In smoke it fled away;
Gone was the Meteor and the shroud,
And night again was gay!

The London Fire Establishment, under the superintendence of Mr. Braidwood, most ably supported by Messrs. Foggo, Colf, Staples, and Henderson, district foremen, continues to prove itself equal to every emergency. The prompt attendance, meritorious exertions, and general urbanity of this corps, frequently elicit the warmest commendation, and I am sorry to observe that in upwards of twenty cases during the past year, their voluntary attendance, and best services gratuitously offered, have not been met with a proper spirit—admission being refused and information denied them. Doubtless, this has arisen from the common error of supposing that the attendance of the firemen has to be paid for; such is not the fact, as I have frequently explained in preceding reports. The services of the firemen are at all times, and under all circumstances, wholly and entirely gratuitous.

The West of England Fire Brigade, under Mr. Connorton, maintain the conspicuous position they have so long held, and are worthy of the office to which they are attached. The general progress of this spirited company is of a most gratifying character; at their 39th annual meeting the secretary's report showed that the premiums received on life assurances during the last year amounted to 144,022*l.* 3s. 8d., of which sum 7,771*l.* 2s. 11d. was derived from 502 new life policies issued within the year, averaging 453*l.* 4s. 6d.;—an amount of business exceeded by few offices in the kingdom. The fire department exhibited a corresponding increase, the amount insured being upwards of thirty-four millions, the premiums producing 87,267*l.* 9s. 0d. The losses were proportionally large, amounting to no less than 70,000*l.* A strong argument this, against the folly and imprudence of persons taking upon themselves this heavy risk. It also shows the caution necessary in the formation of new offices for the transaction of similar business, as well as the necessity for insurers selecting offices, whose character for honour and liberality has been firmly established. The conduct of the West of England office in reference to the fire on the premises of Messrs. Porteus and Co., at Manchester, in August last, has elicited the warmest encomiums of the press throughout the country; the following is extracted from the *Manchester Advertiser*, Nov. 6, 1847:

"The West of England Life and Fire Insurance.—The late Fire in Market-street.—We are very glad to have it in our power to give publicity to the very honourable line of conduct adopted by the Directors of the West of England Fire Assurance Company, in reference to the policy of insurance of Messrs. Porteus, whose premises were destroyed on the 11th of August last. In our report of the particulars of the fire, and the various sufferers thereby, as well as the amount of their several insurances, we stated that Messrs. Porteus were insured for 2,000*l.* in the West of England Fire-office. It appeared, however, on subsequent inquiry, that the policy was void, in consequence of an error in the description of the property made by Messrs. Porteus themselves, and of a smaller premium having been paid than by the rules of the office would have been payable on a correct description. On this discovery, the Directors might have successfully refused any payment whatever; but having made inquiries as to the character and conduct of

Messrs. Porteus and Co. in the affair; and having ascertained that the error was unintentional, they at once recognised the claim, and have most honourably paid the full amount. The facts having come to our knowledge, we feel bound, in justice to the office, to give them publicity, and feel sure the merchants and public of Manchester will appreciate such liberal conduct as it deserves. — *Advertiser, November 6th, 1847.*"

The foregoing forms a striking contrast to some recently litigated cases, in which the "*Argus*," the "*Imperial*,"* the "*Licensed Victuallers*'," and the "*Sun*;" have shown to little advantage.

The *County* Fire Brigade, under Mr. Garwood, have not failed to take advantage of the few opportunities the past year has afforded them for successful exertion:

"THE ROYAL SOCIETY FOR THE PROTECTION OF LIFE FROM FIRE was first established in 1836, but, from imperfection in its early management, its objects were not fully developed; nor its operations carried to any extent, until the year 1843, when the necessity of such an institution became so evident, that at a public meeting, convened for that purpose, the society was re-organized; and from that time its course has been progressive and most successful, giving constant evidence of its usefulness by the decrease of *fatal* fires wherever in operation.

"The principal object endeavoured to be attained by the society, is the establishment of fire-escape stations, half-a-mile distant from each other, throughout the metropolis, and maintaining a body of conductors, well instructed in the use of the "escapes," one at each station throughout the night; it also seeks to stimulate to intrepid exertions in the preservation of human life at fires, by presentation of silver medals and pecuniary rewards.

"There are now 26 stations supported by the society, at distances varying from half a mile to a mile from each other, from Aldgate to Brompton east and west, and from Highbury to Southwark north and south. At each station there is a fire-escape adapted to the locality, attended throughout the night by a conductor well disciplined in its use; and it is his duty to attend every fire in his district upon the first alarm being communicated to him. The early arrival of their men at the fires with the respective escapes, is a matter of general and continued satisfaction to the committee, knowing, as they do, that upon that early arrival depends the important opportunity of saving life: and it is most gratifying to them to be able to state that not one instance has occurred throughout the year of loss of life by fire, reflecting in the slightest degree upon either the arrival or exertions of the conductors.

"The number of fires attended in the year has been 197, being all that have occurred during the hours of duty, within that portion of London covered by the stations; and the number of lives saved by means of the escapes and conductors has been 17—a larger number than during any previous year, but only in proportion to the increase of stations.

"Subjoined is an abstract of the society's operations in thus saving life since September 1843—the time the present Committee have had its affairs under their management.

"In the 15 months ending March 31st, 1845, 116 fires were attended, and the lives of 13 persons saved.

"In the 12 months ending March 31st, 1846, 96 fires were attended, and the lives of 7 persons saved.

"In the 12 months ending March 31st, 1847, 139 fires were attended, and the lives of 11 persons saved.

"And in the 12 months ending March 31st, 1848, 197 fires were attended, and 17 persons saved.

"Making a total of 548 fires attended, and 48 lives saved in the 4 years.

"29, Alfred-street, Islington,
"June 30, 1848."

ON THE PROCESS OF SYNTHETIC DIVISION.

Sir,—Various causes, including an absence from home, have prevented me from acknowledging the obliging answers of Professors Young and Davies to my inquiries respecting "Synthetic Division." It was evident from the terms in which those inquiries were made that information was my object, and not dispute. I wished, if possible, to trace the method from its first rude beginnings up to its final development in the hands of Horner; and I think that those who have had the pleasure of perusing the instructive letter of Professor Davies on the subject will not consider it to have been mooted in vain.

The fact of the existence of Mr. Horner's Latin MS. had not, I believe, been previously made public, and as the

* The circumstances of the case, "Geach v. Ingall," are of so extraordinary a character, that they form the subject of a pamphlet entitled, "*Risks of Life Assurance*," published by Effingham Wilson (pp. 26,) two editions of which have been already sold.

other papers connected with the "Pro cesses" had appeared in the *Phil. Transactions*, the *Mathematical Repository*, and the *Mathematician*, perhaps it would not be considered improper to suggest that considerable service would be rendered to the future historian of Mr. Horner's researches, if the passage from the MS. was printed in your extensively circulated journal.

Though aware of the general principle to which the name of "Synthetic Division" has been applied, my doubts were nevertherless excited by reading in the note on p. 94 of "*Davies's Solutions*" that "this method (synthetic division) was discovered between the composition of the paper in the *Phil. Trans.* for 1819, and June, 1821; as there is no trace of it in the papers on equations, and the method was fully developed in a paper sent to Professor Leybourn for publication in the *Math. Repository* which was transmitted on the last-named day;" "moreover though so early sent to the *Repository*, the number which contained it was not published till 1827;" and afterwards stumbling upon the passage in Francœur as given in pp. 573, 574, of this Magazine, in which undoubtedly a trace is to be found. I was not then aware that Professor Young had noticed the same extract, nor am I "at all offended," to use a diplomatic phrase of some celebrity, by finding myself anticipated by such high authority, or that these "doubts" admit of such easy removal.

From what has transpired it appears that Wells and Garnier made an approach to the praxis of the method:—that Horner essentially possessed the method in 1815; that Francœur actually gave examples in the praxis of the method so far as to divide by the binomials $x \pm a$ in 1819, but unconnected with any general principle, though he seems to have been aware of some of the uses to which the "process," as he terms it, could be applied from the use he made of it in the subsequent edition of the "Cours;"—that Horner essentially gave the method in art. 14, in his paper printed in the *Phil. Transactions* for 1819, and subsequently reprinted in the *Ladies' Diary* for 1838;—that he fully developed the method of "Synthetic Division" in all its generality in a series of papers written in 1820, which were printed in vol. v., N.S., of the *Math. Repository*, and also in another paper written about the same time, and since published in vols. i. and ii. of the *Mathematician*. The only legitimate conclusion therefore appears to be, that though isolated examples of the praxis in certain simple cases had been given by previous writers, to Mr. Horner alone, belongs the merit of having discovered the general principle and fully developed the method.

Into the differences between Messrs. Horner and Nicholson I have no wish to enter, nor is it necessary, perhaps, to discuss the question as to how much one or both were indebted to Francœur, since much on this head must necessarily be conjectural; it may however be added that Horner was certainly acquainted with the writings of Francœur, for he mentions them in a note to his "Horæ Arithmeticæ," on p. 43, part 2, vol. v., of the *Math. Repository*, and as no date is affixed to the note itself, it must consequently be considered as part of the communication dated June 11, 1821.

In conclusion, I would beg to acknowledge my obligations to the two gentlemen who have so kindly responded to my suggestions, but to Professor Davies more especially; and indulging the hope that nothing in the preceding remarks has been expressed in an improper manner,

I remain, Sir, yours, &c.,

THOMAS WILKINSON.

Burnley, Lancashire, July 15, 1848.

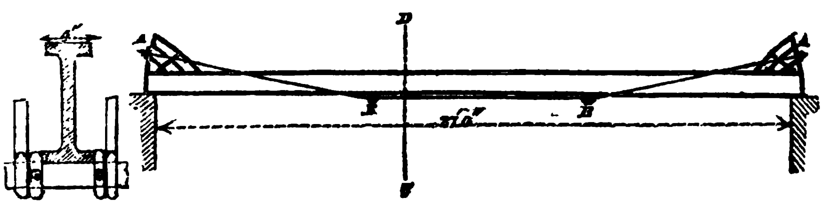
MR. DREDGE'S IMPROVED MODE OF TRUSSING GIRDERS.

Sir,—It may still be within the memory of some of your readers, that a few months ago you published, in the *Mechanics' Magazine*, some papers of mine upon the subject of "trussed girders." I would particularly wish to recall attention to one which appeared in No. 1273, January 1st, 1848, entitled, "Improved Mode of Trussing Iron Girders." I believe I was almost singular at that time in maintaining that the tensile truss was serviceable to the girder, if properly applied; for in consequence of some experiments which had been made with some girders trussed in the usual way, the idea was very prevalent that it was altogether useless. The object of the

paper alluded to was, to show that the inutility of the truss arose from its misapplication, and to propose a plan for applying it, by which the defect would be remedied. The plan I proposed was derived from a mathematical investigation of the action of the girder, and I intended to follow up that investigation with a series of experiments; but finding it would interfere with professional engagements, I did not do so. My plans, however, were referred to the Girder Commissioners, and there the matter has since rested. At the time this letter was published, my views on this subject were entirely new, and I was the first to propose, in conjunction with other improvements, the attaching of the upper end of the inclined truss-bar to the *extremity of the neutral axis of the girder.* My reasoning upon this subject gave rise, in some respects, to objections; but some experiments lately made by Mr. Cubit, at Thames Bank, now prove, most clearly, the truth and value of my suggestions; *for, by merely altering the points of attachment of the ends of the inclined truss-bars, an advantage of* 50 *per cent. was obtained.* In the letter to you above alluded to, which is dated 22nd Dec., 1847, after some description of the diagrams which are given, I observed—

"There are, therefore, two difficulties to overcome, in order effectually to apply the truss to the cast girder. First, to prevent the prejudicial compression in the line A B (the upper line of the girder), which, I have shown above, weakens the girder to the extent of such compression; and, second, to allow for the difference in the elasticity between cast and wrought iron. The first of these difficulties I propose to overcome by attaching the upper end of the tension-bars to the girder, either at, or rather below the neutral axis. In figs. 3 and 4 it is connected at the neutral axis at the points a and b. The effect of this is, to bring the compressive reaction of the truss to the neutral part of the beam, which is useless as far as transverse strain is concerned, but may be advantageously employed in resisting the pressure, which, if applied above the line a b, would prejudice the strength of the girder. By connecting the tension-bars at these points, therefore, instead of at the points A and B (figs. 1 and 2,) the girder is increased in strength by the truss very nearly as much as is due to the tension in the bar."

In No. 284 of the *Builder*, published the week before last, the particulars of Mr. Cubit's experiments are given, and from that article I make the following quotation: "The girder was of cast iron, 28 feet long, 10 ins. in depth, parallel, and of the same section throughout; a strong frame was cast upon the ends of it, in order that the inclination of the tension-rods might be varied, or rather that the ends of them might be raised to different heights above the bottom flange. The tension-rods were of wrought iron, 1 inch in diameter, one on each side of the girder, attached at the point B B to iron pins 2 inches in diameter, which passed under the bottom flange; at the points A A they were connected by means of plates clipping the ends of the girder, and tightening up by nuts and screws. A weight of 4 tons was placed upon the centre of the girder, and the deflection (2 inches and 1·8 inch) carefully taken.



The tension-rods were then put on, and applied in various places, and the weight required to produce the same deflection is given in the following table. The distance of bearing was in all cases 27 feet. After the above experiments had been made, the tension-rods were removed, and the deflection with four tons was found to be the same as at the commencement. Our readers will observe that, strange as the fact may appear, when

TABLE.

No. of Experiment.	Distances of points A A above the bottom of the girder.	Distances of the points B B on centre of pins below the bottom of girder.	Weight required to produce the same deflection of 2¼ inches.	
	Inches.	Inches.	Tons.	Cwt.
1	30	1	3	19
2	24	1	4	0
3	18	1	4	1
4	10	1	4	11
5	24	6¼	4	8
6	10	6¼	6	1
7	5*	6¼	5	12

one end of each tension-rod was 30 inches above the bottom of the girder, and the other end one inch below the bottom, the same deflection was produced by one cwt. less than when there were *no* RODS.† When the distance of the points A A above the bottom of the girder was lessened to 10 inches, and the distance of the points of suspension (B B) below the b ttom of the girder was increased to 6¼ inches, the girder was strengthened 50 per cent."

I am just now preparing models on a sufficiently large scale to test by experiments the comparative value of the designs proposed in my letter of the 1st Jan. last; and I think that, without at all increasing the weight, and by merely altering the arrangements of the truss in the way proposed, I shall obtain an increase in the strength of 100 per cent. At all events, as soon as I am in possession of the results, I shall have much pleasure in laying them before your readers.

I am, Sir, yours, &c.,

WILLIAM DREDGE.

London, 10, Norfolk-street, Strand, July 18, 1848.

THE GRESHAM PROFESSORSHIPS.

Fourth Notice.

The play is played out! We happened to "foreknow" its *denouement*:—for we knew the means which had been taken, and the influences which were brought into play, to accomplish the result; and we knew, too, that "election" meant only a prescribed ceremony to render formally valid a pre-ordained fact. We venture, however, to predict, as we have predicted before, that this is the last instance of an appointment to the geometry professorship that will be made under similar circumstances. Guarded though that hoary corruption, the Gresham trust, is by City influence and Acts of Parliament, it is not altogether invulnerable; and it is more than possible that a stringent investigation of the entire system of City trusts might hinge upon an "unconsidered trifle" like the perversion of a *scientific and literary trust* committed to the joint charge of the Corporation and the Mercers' Company. It is a curious circumstance—and it is ominous, too—that the last professor of geometry in Ward's list (1740) was the father of the celebrated "Abraham Newland," cashier of the Bank of England, and who is described as "George Newland, LL.D., *Member of Parliament for Gatton, in Surrey!*" What an exquisite analogy between the two parts of this pluralist's offices—the Gresham professorship of geometry and the representation of Gatton in the House of Commons! But the fate of Gatton will be the fate of the Gresham: the functions of this body, like those of Gatton, will be transferred to a body more competent to exercise them discreetly and honestly.

* In experiment 7 the truss-rods were strained more than in either of the other experiments; for, though in 6 it sustained 42 cwt., and in 7 only 33 cwt., yet, in consequence of the less inclination in the bars in the latter, the strain then was much more severe.

† The cause of this "*strange fact*," the reader will find fully explained in my letter to you which was published on the 1st of January, 1848.

We had intended in our present number to complete our sketch of the *history* of Gresham College, which was begun last week; and especially to dwell at some length upon what a writer in the *Athenæum* (July 22, page 727) calls "the nefarious juggle of 1768—which stamps with equal infamy the Corporation, the Gresham professors, and the Government of that day." We find that, unless we pass over the farce of "election" which has just been performed, we shall not have room to do justice to the "nefarious juggle" of other days. One such "juggle" at a time furnishes matter for as much indignation as the honest human breast can contain at once.

There were six candidates, and *all were Cambridge men*:—some of them men of high mark, as we shall presently see, but still of very different pretensions and claims, for this particular chair. Of course, our means of information respecting them personally are but scanty; but they are, we believe, sufficient to enable us to lay down fair criteria of their relative merits. Amongst these criteria we consider their places, as arranged after the senate-house examinations, to be indisputable indications of their powers in respect to mathematics generally; and the works which they have since published to be equally indisputable indications of their present powers. The nature of their duties subsequent to the B. A. degree, will somewhat aid our judgment; and the particular features of their city connections will explain the remainder of *this juggle*.

1. *Mr. Robert Pitt Edkins* (Trinity College,) the newly appointed professor, was 25th senior optime in 1830:—in which year there were 40 wranglers, 35 senior optimes and 20 junior optimes. Of 95 men who obtained honours in 1830, the Gresham professor was the 65th! Not a very exalted position, certainly. Eighteen years have passed away, and during that long period we believe Mr. Edkins has not either eked out one truth in mathematical science, or published a single line on any subject. We shall be glad to be informed by Mr. Edkins, or his friends, what the nature of his *scientific claims* are, that justify his aspiration to the post he now occupies. If he have such, we shall willingly give them publicity; but if his friends leave us in the ignorance of them in which we now are, the fault is theirs, and not our own—for we do presume that he has no scientific claims to that appointment, for one moment to be compared with the claims of most of the other candidates.

Mr. Edkins, however, had other claims—claims which weigh more than those of science—the claims of city connection and influence. He is the son of Mr. Edkins, *the common councilman*: and therefore "entitled to the fraternal support of the Gresham Committee." He is the son of a coal-merchant in Whitefriars, and therefore was sure to be preferred by such persons as those whose names we gave in our second notice (*ante* p. 68,) on the "fraternal principle." He is moreover the mathematical teacher in the City of London School, in which of course the sons of these *aristocratic electors* are educated; by which means he would be brought into an interesting (if not interested) relation to these city-donnikins. Of course it did not surprise us to hear (and we heard it before we had written a line on the subject) that within less than two days after the death of Dr. Birch, Mr. Edkins *had obtained the promises of eight votes out of the twelve without any testimonials!* How Mr. Edkins could look upon such an appointment as other than a corrupt one, whilst he was canvassing the trustees to elect him to an office which demanded profound acquirements and no ordinary talents, (in the teeth of men infinitely better fitted for the duties of the post who might offer themselves for it,) can only be explained by Mr. Edkins himself. Whether persons who could give their promises, too, without previously knowing who and what the other candidates might be, are *morally* fitting depositaries of such a trust as the Gresham professorships, our readers can judge for themselves; and whether they can be, by any possibility, adequate *intellectually* for that trust, will be best answered by the list of their names already given.

That Mr. Edkins has been a painstaking schoolmaster we are ready to admit—for we are told he is such. The habits of the schoolmaster's mind are, however, *precisely the reverse* of those required in a Gresham lecturer; and, indeed, it may be fairly doubted whether the mental habits and personal demeanour involved in the duties of schoolmaster

and lecturer, be not too antagonistic to be ever effectively and contemporaneously developed in the same man. The Gresham Committee think otherwise—or at least so affect to think—and have elected Mr. Edkins to a snug sinecure which has fallen to their disposal. This gentleman will, however, read "bare-wall-lectures" as well as his colleagues and predecessors; the citizens of course will be satisfied, whatever the public may be. We shall, however, *try to form an audience for him;* and we may, possibly, from time to time report his "saying and doings" in his new official capacity.

2. *Mr. Robert Potts* (Trinity Coll.) was 26th wrangler in 1832:—when there were 35 wranglers, 39 senior optimes and 24 junior optimes. He was thus 25th in a list of 98 men who obtained honours. Mr. Potts's claim, however, to the Gresham Professorship of Geometry, rests upon still higher grounds than his place on the tripos; for in this respect he must be placed below two of the other rejected and insulted candidates. His claim rests upon the firm basis of *what he has actually done in and for geometry.* It has never fallen to our lot to read so many high testimonials to the scientific merit and personal worth of any man who was a candidate for such an appointment, as those which have been given to Mr. Potts; and it is to us a matter of wonder that any set of men, even of the class who compose the Gresham Committee, could look on these testimonials and then vote for Mr. Edkins without compunction, or a blush. It can surely result from no cause short of their ignorance of the scientific and social stations of the distinguished men who gave those testimonials. Such ignorance is to be anticipated in such men; and were it not for the mischievous consequence of their ignorance to society and to science, it might pass among the commonplace phenomena of the city-mind as unworthy of especial notice: but in such a case as this, it places conspicuously the degradation of science in this country, when we contemplate the class of men into whose hands the endowments for its cultivation have ultimately fallen. It almost compels us to believe that wherever money or influence is concerned, all trusts must become corrupt—the corruption of ignorance, and often more criminal corruption still—seeming to pervade them all! To show that we do not speak heedlessly, we will quote the testimony of two gentlemen, who have probably the highest claim to be heard as authorities on this question that could be named amongst English geometers — Professors De Morgan and Davies. The former says: "If the word Geometry be used in this limited sense [the antient geometry] then Mr. Potts has *very high claims indeed:* for he is one of the *very few* persons who have paid attention to that now rather neglected subject. In fact, the word Geometry being thus used there are but two or three persons on whom the choice would properly fall, of whom Mr. Potts is one." The latter says: "Mr. Potts is one of the ablest geometers of our time"—he has "rendered greater services to the cause of geometrical learning than any living writer—he has in fact, if I may so speak, re-created the spirit of pure geometry in England—if your choice shall fall upon him, you will have chosen the man best fitted of all who are in a position to become candidates, for carrying out in their true spirit the high design of Sir Thomas Gresham." Yet in spite of such testimonies as these, and nearly fifty others to the same effect from the Vice-Chancellor of Cambridge, the masters of half the colleges in Cambridge, more than half the professors in the University, and from resident and non-resident members who stand foremost in the literary and scientific world, Mr. Potts was rudely set aside, in favour of a man alike unknown to science and to letters.

3. *The Reverend Benjamin Morgan Cowie* (St. John's) was senior wrangler in 1839:—when there were 41 wranglers, 52 senior optimes, and 30 junior optimes; that is, he was first on the list of 123 men who obtained honours. This position, we should have thought, would of itself, apart from all testimonials, have induced the Committee to pause ere they committed themselves to public scrutiny for an indefensible choice. He can be no ordinary man who attains to such a position as Mr. Cowie: nor is Mr. Cowie an ordinary man in any sense of the word. As a mathematician his early place is fixed by the tripos-list as superior to all his competitors; and we know moreover, that his subsequent pursuits have been of a kind to earn for him the

respect and gratitude of all who are interested in the application of mathematics to *practical science*. Had Mr. Cowie remained in the University we should, we are sure, have had printed proofs of his great ability as a teacher of science; but having undertaken a post of great responsibility and immense exertion, as Principal of the College for Civil Engineers, it has been impossible that he should have contributed so much to our scientific literature as he would have done in case he had remained a Fellow and Tutor of St. John's.

We have spoken of Mr. Cowie as an *analyst*, and as (for want of a suitable English word we use the expressive French one) a *physicien*; of his acquirements and talents in *pure geometry*, we, however, are less able to speak, from our having nothing before us from which to judge; though we are led to believe that the power evinced by him on other subjects would not be found at fault in this special application of them. Mr. Potts's claims, however, we consider to be preferable to Mr. Cowie's, *in this case*, under all aspects.

4. *The Reverend Henry Moseley* (St. John's College,) was 7th wrangler in 1826:—when there were 27 wranglers, 32 senior optimes, and 26 junior optimes: thus giving him the 7th place amongst 85 men who gained honours that year.

Mr. Moseley, like Mr. Cowie, has led an active life out of the University, as Mr. Potts has led an active life in it. He has, too, the additional claim to attention which arises from his having evidenced by his writings that he has continued the studies upon which his academic days were spent, and still more by his important researches connected with the practical application of physical science. His papers in the "Philosophical" and in the "Cambridge" "Transactions" deal effectively with subjects of confessedly great difficulty; whilst his "Mechanics of Architecture and Engineering," besides its usefulness, contains a larger amount of originality than we commonly meet with in any books of a didactic class. His little work on "Hydrostatics" is possessed of great merit; and his popular volume "Mechanics Applied to the Arts," betokens a considerable amount of that happy power of illustration which is essential to a successful lecturer. We see in none of these, however, any traces of that intimate acquaintance with *pure geometry* which is indispensable in a Gresham Geometry Professor, if the chair is to be other than a sinecure to the holder and a mockery of the public. The cast of his mind, indeed, like that of Mr. Cowie, seems to be in the opposite direction from geometry.

Mr. Moseley was for some years professor of natural philosophy in King's College, London; and his lectures and writings raised that school much in public estimation. He has subsequently been, and still is, one of her Majesty's Inspectors of Schools. We should think, indeed, that the duties of this office would have left him but little time to devote to the Gresham lectures, even had he been appointed. This, however, is no answer to the conduct of the Gresham Committee; for it was not on this ground that either he or Mr. Cowie, much less Mr. Potts, was rejected.

5. *The Reverend Thomas Pelham Dale* (Sidney Sussex College) was 25th wrangler in 1845:—when there were 38 wranglers, 41 senior optimes, and 35 junior optimes:—thus making him the 25th out of 114 successful candidates for honours.

This gentleman is the son of the Rev. Thomas Dale, late vicar of St. Bride's, and now rector of the large and populous parish of St. Pancras, and likewise canon of St. Paul's. For so young a man, we should think that he is sufficiently provided for by the rectory of St. Vedast, Foster-lane (value, £300 a year, and fees,) which is in the gift of the Dean and Chapter of St. Paul's, and therefore obtained through the paternal influence of the canon himself: "He that provideth not for his own, and especially those of his own house, hath denied the faith, and is worse than an infidel;" and as long as our clergy can quote such an authority as this, we cannot wonder to see all grades of the Protestant hierarchy acting in "a way *so extremely natural*."

We know however, and bear our testimony to that knowledge, that Mr. Dale is a man of real ability; and his degree bespeaks that he had acquired a fair amount of that learning upon which the University insists for conferring degrees in honours. Our objection to his appointment rather consists in this:—his inex-

perience—and the impossibility of his having added much to the mathematical knowledge which he took into the senate-house, from the attention which was imperatively given to theology and his clerical duties. We are, indeed, surprised that he should offer himself for such a post as the Gresham professorship; and we can only account for it on the hypothesis that the idea of "pluralities" is indigenous to the clerical mind.

6. *Mr. Joseph Gibbs* (Queen's College) was 10th junior optime in 1832:—or 84th on a list of 98 in Mr. Potts's year. Of this gentleman we know little more than the bare academic record tells us; and that little is, that he is a near connection of the celebrated alderman who bears the same patronymic. We have heard that he is in holy orders; but as we are not sure, we have not so entered his name. He has, at all events, taken effectual care that the scientific public shall know nothing of his talents or acquirements, if any such he have; and we are therefore only able to judge of him by his place on the mathematical tripos. Here, in all conscience, he stands low enough—and here, since he so wills it, we shall leave him. He must have relied on the alderman's influence; and perhaps had not that gentleman somewhat scandalised the city by his "unaccountable" eccentricities, Mr. Gibbs, though lowest of all at the University, would most likely have been appointed to the Gresham chair. In default, however, of the alderman's popularity, *the committee have chosen the next lowest on the list!* Do men so perverse as the citizens of London exist elsewhere upon the face of the earth?

In reviewing the circumstances and claims of the several candidates, we should say that Messrs. Edkins and Gibbs, not being first class men, should have been set aside at once, as ineligible candidates. Our views on the significancy of the several Cambridge degrees have been more than once expressed (but especially at vol. xlvi., pp. 356—392) and need not be recapitulated here. Their having lived so many years in perfect scientific obscurity too, does not add to their claims. The other four were first class men, and therefore all entitled to consideration, and to have their claims fairly balanced against each other. These claims we have attempted to weigh with perfect candour: and we feel no diffidence in affirming that (whilst we allow to Messrs. Cowie and Moseley very high praise, and to Mr. Dale full reputation for the power which he does possess,) of all the candidates, Mr. Potts is the one who came before the Committee *with the requisite credentials of his entire fitness for the Gresham Professorship of* GEOMETRY.

NOTES AND NOTICES.

Steam Navigation on the Caspian.—It had long been part and parcel of the superstitions prevalent among the Astrachan mariners, that, from the violent storms and billowy fury of the Caspian, no steam vessel would be able to navigate it. But modern skill and invention have put the figment to flight. About three years ago, Captain Netschuyeff arrived at Astrachan, took command of the Kaux steamer, embarked under the prediction that he and his bold men were doomed to a watery grave, and reached the Trachmenian shore in safety. The success of the experiment has given a lively spirit to steam navigation in that quarter, and the credit of the mercantile craft, which consume eight days in reaching the Persian coast from Astrachan, has consequently sunk to zero. An earth, saturated with naphtha, affords the steamers a good substitute for coal.

Quicksilver Superseded in Mining.—The following is an extract from a recent letter from Valparaiso: —Both here and in Peru, the miners are quite mad about a new method of separating the metals from the ores by means of salt and water, without the use of quicksilver; but, as far as I understand, this system has only been found to answer in a few individual cases, and can only be applied to a peculiar sort of ore. The introduction of the plan has, however, undoubtedly rendered the miners shy of purchasing any more quicksilver than they absolutely require to carry on their operations. It remains, therefore, to be seen if it will answer their expectations, and in a few months the question will be decided."

Messrs. Deane, Dray, and Deane's Portable Fire-Engine.—We find that we were in error (*ante* p. 75) in our statement respecting the registration and exhibition of this engine. It was the night-soil cart of the same parties, described vol. xlviii., p. 145, which was exhibited at York, and obtained a prize medal.

Mr. Joseph Woods' Chronometric Governor.—We perceive from the police reports in the newspapers, that an infamous attempt has been made to obtain money from Mr. Woods, by a person of the not inappropriate name of Robert *Booty* Cousens, for the suppression of a paper on "Governors," and in depreciation of that of Mr. Woods in particular. Mr. Woods has acted on the occasion as might have been expected from his high character—set the literary bravo at defiance, and left the merits of the invention to speak for themselves.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Chevalier Alexandre Edward Le Molt, of Conduit-street, Middlesex, for certain improvements in apparatus for lighting by electricity, parts of which may be made use of in other applications of electricity. July 20; six months.

David Napier and James Murdoch Napier, of York Road, Lambeth, engineers, for improvements

in mariners' compasses, also in barometers, and in certain other measuring instruments. July 29; six months.

William Thomas, of Cheapside, merchant, for improvements in the manufacture of stays, boots, and shoes, also in fastening and connecting fabrics and garments. July 26; six months.

John King, foreman to Messrs. Shears and Sons, of Bankside, and Henry Medhurst, operative engineer to the said Messrs. Shears and Sons, for improvements in gas meters. July 26: six months.

Charles Hancock, of Brompton, Middlesex, gentleman, for improvements in apparatus and machinery for giving shape and configuration to plastic substances. July 29; six months.

John Grist, of the New North Road, Middlesex, engineer, for improvements in furnaces and fireplaces. July 29; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
July 21	1511	Pretyman and Hobson,	Cornhill	Child's cot.
"	1512	Samuel Alfred Carpenter	Birmingham	Wedge apparatus (applied to the fronts of a brace, and applicable to other uses.)
22	1513	Samuel Minshul	Birmingham	Hearse to be drawn by hand.
24	1514	James Rowland, William Rich, and Robert Harris	23, New Bond-street	The aptandum trousers.
25	1515	W. and F. Thorn	John-street, Cavendish-square	The æquimotive spring.
"	1516	R. W. Winfield	Birmingham	Gas burner.
"	1517	Stock and Sharp	Birmingham	Gas burner.

NOTICES TO CORRESPONDENTS.

D. H. and friends *are very unreasonable. Before acceding to the request of a numerous section of our readers to bestow more of our space on mathematical subjects—an increase called for by the increasing attention happily paid to them by engineers and mechanics—we made an addition of an entire half to the number of our pages, without making an additional charge to our readers; so that those who do not like our mathematics have, over and above, more for their money than is given by any other scientific journal whatever.*

Casuist.—*The case of Dr. Barnes's "election to the Professorship of Casuistry in the University of Cambridge" is a curiosity in the way of elections. We shall notice it hereafter, as well as a few other matters of the same kind. Dr. Whewell, however, the successor of Dr. Barnes, makes no sinecure of the appointment; and we only wish the Gresham Professors would follow so honourable an example.*

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BLACKWELL'S PATENT IMPROVEMENTS IN EVAPORATING FURNACES.

Fig. 2.

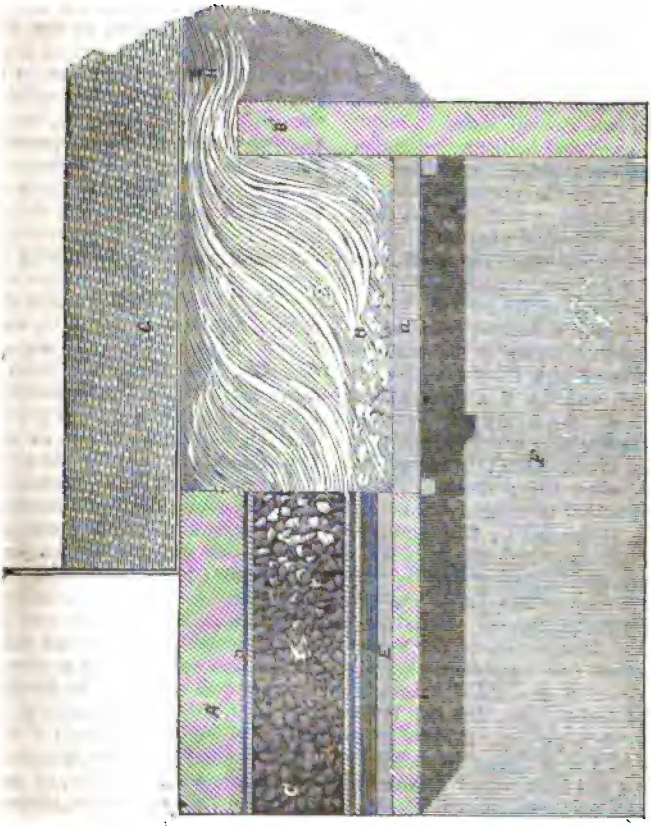
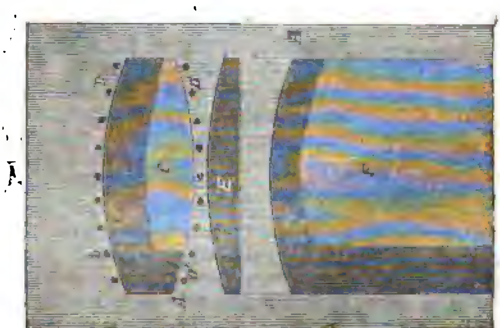


Fig. 1.



BLACKWELL'S PATENT IMPROVEMENTS IN EVAPORATING FURNACES.

[Patent dated February 2, 1848. Patentee, James Blackwell, of Winsford, Salt Proprietor. Specification enrolled August 2, 1848.]

Specification.

My invention has relation generally to all furnaces employed for the purpose of evaporating fluids, or bodies in a fluid state, as water, brine, oils, syrups, &c., and has for its nature or object the producing and sustaining of an intensity of heat in such furnaces greater than usual, a saving in the consumption of fuel, and the avoidance or diminution of smoke. And the manner in which the said invention is performed, is fully set forth in the following description thereof, reference being had to the accompanying figures; that is to say, the said drawings exemplify my said invention as applied to a furnace suitable for the evaporation of brine or manufacture of salt. Fig. 1 is a front elevation of this furnace, and fig. 2 a longitudinal section of it. AAA are the external walls of the furnace, which are formed throughout of fire-brick; B is the fireplace, and *a a a* the grate-bars; B^1 is the bridge, which is composed, like the outer wall, of fire-brick; C is an ante-chamber, through which the fireplace is supplied with fuel in manner to be presently explained. DD D^1D^1 are two sets of air holes formed in the front wall of the furnace, immediately over and under the fuel supply chamber, C, which holes lead into the fireplace, B, and are left always open. Beneath D^1D^1 there is an open passage, E, leading to the part of the fireplace immediately above the grate bars, which serves also as an inlet for air, and through which all such solid residual matters as are left on the bars are raked out from time to time. F is the ashpit; G, saltpan; and H the passage to the chimney. The manner of operation is as follows:—A fire is first made in the fireplace, B, with wood and coal, as usual. The ante-chamber, C, is then filled to the top, and from end to end, with coal, or good coal-slack. The fire, as it burns in B, gradually cokes the green or crude fuel in the adjoining chamber, C, and draws from it various gaseous vapours, which contribute more or less combustible matter to the fire. When the original supply of fuel to the fireplace, B, begins to be exhausted (which the person in charge can readily ascertain by looking through the open passage, E,) a further supply is furnished by pushing forward the contents of the ante-chamber, C, and to the extent of the void thereby made in that chamber, it is refilled with fresh coal or coal slack. When that second supply is nearly consumed, a third is pushed forward in like manner, and so on. For the first time or two that the contents of the ante-chamber, C, are ejected upon the fire, they are commonly in an imperfectly coked state, and there is, consequently, a considerable escape of smoke (or unconsumed fuel) from the chimney (though still much less than usual;) but after the fire has been well got up, and the walls of the furnace have become thoroughly heated, the coking keeps so ahead of the consumption of fuel in the fireplace, that there ceases to be any discharge of crude fuel into the fire, and only a colourless or imperceptible vapour is emitted from the chimney. The whole, or nearly the whole, of the combustible matters in the fuel are thus turned to profitable account, and a saving of fuel is the result, much exceeding, I believe, any which has been hitherto effected.

THE GRESHAM PROFESSORSHIPS.

Fifth and Final Notice.

We are sure that every one of our readers will consider it to be, to him, a matter of personal concernment that justice should be done to every man; and that every trust which has been confided by liberal and enlightened men in past ages for the public benefit, should be so administered as to conduce in the utmost degree to the advantage to society. Heavy indeed is the guilt of those trustees who, to favour their friends, or enrich themselves, divert the property so bequeathed from its legitimate purposes. Yet how few trusts exist at the present day which have not been disgracefully abused—nay, how few that are not *totally diverted* from their intended uses? Even Sir Thomas Gresham, far-seeing as he was, could not anticipate the possibility of the trustees of his gift ever belonging to the *relative* class they now do. He thought they would be "mer-

chants" in the sense which the term bore in his own day—men of intelligence and high principle. The revolution of events, however, has led to such a state of things, that the great merchants of the city and the proper representatives of Gresham, have no more to do with the city-rule, city-trusts, or city-morality, than if they were located in the Isle of Skye. All is left to mere retail tradesmen; and of course we cannot look (as a rule, though there are many exceptions,) for cultivated intellect, nor still less for a high code of business-ethics. This will explain perhaps, in some degree, the singular circumstances upon which we have already commented; and we proceed to complete our sketch of the "History of Gresham College."

It has been customary to eulogize the provisions made in the "tripartite deed" for conducting the lectures, as the emanation of perfect wisdom; and one author, even of the present day, and of considerable literary eminence, has offered a defence of them.* We disagree with him—at any rate, as respects the present state of knowledge. It is hard to discover why the professors should be tied down to such an antiquated course of lectures; but the fact, perhaps, is, that a set of such lectures is more easily manufactured than a more modern one would be, and therefore may suit the sinecurist all the better. In the judgment, however, of all intelligent men, the conditions of that deed require very important revisions—in fact, to be thrown aside, and an entirely new set drawn up, so as to be in accordance with the present state of our knowledge on the several subjects. There is nothing in the Will itself to prevent this; nay, the Deed itself does not declare those regulations to be perpetual. The same power which made them, can either modify or revoke them.

Neither is there any rule in the Will or in the Deed that gives the professor a *life interest* in the appointment. There is nothing we believe, in *any deed or agreement* that would prevent the stipulated period of occupation of those chairs being for any given number of years, as three or five. In fact, there exists neither moral nor legal difficulty in the trustees rendering their college all that we pictured in our second notice (*ante* 64—9,) except, indeed, their ignorance, apathy, selfishness, or nepotism.

The early professors were, for the most part, men of ability (though even then there were exceptions): as, for instance, Briggs, Graves, Rooke, Barrow, and Hooke, in Geometry; and Brerewood, Gunter, Gillebrand, Rooke and Wren, in Astronomy. Yet even so early as 1647 complaints were made (and even a tract published on the subject) of the unsatisfactory character of the lectures then delivered. One complaint was, that the lectures were only read in term-time: and it proceeds to say that the lecturers were "so superbiously pettish, that they will resolve no quære that may advantage the dubitor: nay, they are come to that strain that they will doe as they list; read whatt, when, how, and where they list; and not at all if they list; and indeed they have their meanes for a song," ("Sir Thomas Gresham, his Ghost," 1647). How far there may be good grounds for these charges it is impossible to discover; but at any rate it is a true picture of the subsequent state of things in this College. We think it likely, however, that this was a contest between the citizens and the lecturers, as to whether the assigned duties were *Professorial* or *Tutorial*.

Before the close of the century, however, there appears to have grown to maturity a design to pervert the objects of the College, and even to partially alienate it. In 1701 this intention was publicly announced; and for two years the salaries of the professors had been then unpaid! The trustees alleged that they were losing 2,000*l*. per annum by the trust: but that, as far as we have been able to learn, rests on their own unsupported and unavouched statement. At any rate Gresham College and the eight Alms-houses together did not draw upon them for more than about 400*l*.; and if we put down 100*l*. per annum for repairs, we still only arrive at one-fourth of the sum which they stated to be their loss upon the trust, as far as the Gresham College and Almshouses were concerned. Nevertheless, upon a statement like this, the College itself must be sacrificed! They then discovered that "good conveniences may be made for the seven lecturers on *part of the ground*," and

* Life and Times of Sir Thomas Gresham, by John William Burgon, vol. ii. p. 526.

that "the remaining part, *at a very moderate valuation*, will let to build for 430*l*. 12*s*. per annum ground rent, *upon leases of fifty-one years*." (The reader is desired to keep this statement in mind for a few minutes.) A bill was brought into Parliament at the instance of the City, the Mercers, and the Lecturers, to empower them "to pull down the present building called Gresham College, and to make such building for the said Lecturers as was agreed upon, which would be convenient; and to empower the said city and company to make the best improvement of the remaining ground they could, *for the benefit of the said corporations and their successors*." The bill, however, was rejected by Parliament from its manifest iniquity—as an attempt on the part of the Trustees to transfer the claims of the Professors upon the rents of the Royal Exchange, (upon which the salaries were charged by the will) upon the property of the College itself.* In short, to defraud the College of that amount of money. To bring the professors into the scheme, the trustees had for two years previously refused to pay them their salaries; and held out to them that it was only by the means then proposed, they could ever expect to receive another shilling!

Sixteen years later (1617) they presented another petition to Parliament for leave to bring in a bill "to empower them to pull down the said College and Almshouses," and "let the ground on lease for building good houses upon it for merchants and others." In this, however, they pledge themselves only "*to erect or provide a proper or convenient room for the public exhibition of the said lectures*."

This bill was rejected, like the former: but, in nearly the same form, it was revived in 1760; and was again negatived in the House of Commons.

The year 1768, however, consummated the desires of the Corporation; those desires which had been growing with more and more intensity for nearly a century. The Royal Exchange virtually was freed from the maintenance of Gresham College, and its revenues were converted to Corporation uses solely; and this immunity was purchased by a bribe to the minister, such as few instances in the history of political and Corporation jobbing can parallel. The whole transaction can only bear the name of a base fraud; for which deeds not a hundredth part as criminal have caused a hundred executions at the Old Bailey, both before and since. The scheme now no longer *appears* as a City job; and the Act (8 Geo. III. cap. 32) merely enables the Government to fulfil an agreement already entered into between the Corporation and the Secretary of the Excise. It is, in the preamble of this Act, made to appear that the entire scheme is one to facilitate the transaction of public business; and had we no other knowledge of the case than this preamble affords, it would rather appear to arise from the necessities of the public service, than to be the maturation of a scheme of the Corporation itself, which had been brought forward ostensibly but successlessly no less than three times before, within the preceding seventy years.

The Act itself contains eleven clauses, the preamble being the *first*. By this, "from and after the 25th of March, 1768, the messuage called Gresham College and the ground, &c., thereunto belonging (which is specifically described by means of the lengths and bearings of its boundaries) with all rights and privileges belonging to and enjoyed therewith, are declared *to be vested in and annexed unalienably to the Crown*."

Ward, who wrote in 1740, thus describes this sacrificed College:—"The situation of the place, spaciousness of the fabric, extending westward from Bishopsgate-street into Broad-street, with the eight almshouses situated at the back part of the house; the accommodations for separate apartments of the several professors, and other rooms for common use; the open courts and covered walks; with the several offices, stables, and gardens; seemed all so well suited for such an intention, [to be used as a college,] as if Sir Thomas had it in view at the time he built his house. The stipends of the professors were also *very handsome for the time*,* and a

* Dr. Hooke died early in 1702, and his place as Geometry-Professor was not filled up for more than two years. It would therefore appear that the salary for one lecture was left five years in abeyance,—and then not paid at last.

* They were equivalent to about 475*l*. per annum, estimated in terms of our present money—and the poor Professors doomed to a celibacy!

proper encouragement for persons of the best abilities in the several professions. Sufficient care was likewise taken that the two Corporations, to whom this affair was entrusted, might receive no damage by the execution of it. For, the stated annual payments, directed by the will, amounted to no more than 603*l.* 6*s.* 8*d.*; and the yearly rent of the Exchange received by Sir Thomas Gresham was 740*l.*, besides the additional profits that must arise from time to time from fines, *which were very considerable.*"

The *second clause* enacts, that "*in full satisfaction for which* there shall be paid out of the revenue of the Excise-office to the City of London and the Mercers' Company, *an annuity of* 500*l.* *per annum;* the same to be paid quarterly, and the first payment to be made on the 25th of Dec., 1768."

The dimensions given in the "preamble" are insufficient for *testing* the plotted plan of the ground; and the construction of it according to those dimensions does not seem to be altogether consistent with the view of the College by George Vertue, (one of the most accurate draughtsmen and engravers of his time) in Ward's Lives. From the rough plot which we have made of it, the area of the ground thus alienated is considerably more than an acre! This ground is in the very best and most valuable part of the City:—and it has *been alienated in perpetuity for an annuity of five hundred pounds per annum.* It is worth at this moment *full ten times* that sum, on leases of fifty-one years: which with the fines, would have now produced probably six thousand per annum! Besides, the Corporation stated nearly seventy years before, that a *part only* of this — the part *then proposed to be alienated on lease,* would produce, "at a very moderate valuation, the sum of 430*l.* 12*s.* per annum;" whilst now *the entire site* (cleared of buildings too, at the expense of the Mercers' Company) is sold for only 500*l.* per annum; and all fines foregone, by vesting it in the Crown in perpetuity!

It is impossible to apply any of the ordinary maxims of business to this transaction; for nothing like it has ever appeared as the act of sane men, if *the whole consideration for the property be fully set out* in the Act itself. It is here the "nefarious juggle" is made manifest: for the Corporation has always been most jealous of its privileges and property; and it will only give the *quid pro quo,* even to the Crown itself. We must therefore either consider the Corporation of that day to have been absolutely demented, or else that it gained more by the bargain than has been divulged. That in a future age some curious antiquary, by a comparison of City-records and cotemporary State correspondence, will bring the secret of this "nefarious juggle" to light, we feel absolutely certain.

The remarkable part of this business has been, that the Corporation and Mercers' Company did not (as far as hitherto published documents show) lighten the burdens of which they had been for almost, or quite, a century complaining; so that in fact they affect to have done what was *equivalent to making a present of the site and materials of the entire College to the Government!* In the first place, they give 7 × 50 (or 350*l.*) a year to the Professors, as a compensation for their "Lodgings"; then 1,800*l.* for "pulling down" the College—equivalent to 90*l.* a year; and then the establishment of the eight Almshouses, which would be worth at least 60*l.* a year:—thus making a total of precisely the 500*l.* a year for which they alienated the entire building and site of the College.! Those who can believe that the Trustees were such simpletons as this would imply, may do so:—but we cannot. As, moreover, the real consideration that was actually given for this alienation does not appear from the Act itself, we feel ourselves fully justified in describing it as one of the most scandalous and dishonest proceedings that has ever been laid before the public. The mystery of the business is,—that the Corporations were still liable for the original salaries assigned to the professors by Sir Thomas Gresham, and which seventy years before they had professed themselves unable to pay: so that in no respect whatever did the trustees *appear to have* accomplished the objects for which they had so long struggled,—and which was the *ostensible purpose* they had so long aimed at. The least we can say is, that "they were," in plain English, "either *knaves* or *fools.*" We have never seen a *pecuniary fool* become a City-man, and if our readers' inference be different from

our own, his observations must have been made upon a *rara avis*, whose acquaintance we should like to make.

The *third clause* empowers the Corporation to sue the Receiver-General of the Excise in the Court of Exchequer for payments not duly made, and the verdict to carry full costs.

The *fourth clause* recites, that "the said seven persons so chosen, nominated, and appointed to read the said lectures, and the said eight alms-folks, the better to enable the Mayor and Commonalty and Citizens of the City of London, and the Wardens and Commonalty of the mystery of Mercers of the City of London, to perform their part of the agreement entered into as aforesaid, *have respectively agreed and consented to relinquish and quit their apartments and almshouses.*" It then enacts that "50*l.* per annum, clear of all taxes, shall be paid by the City to their several Lecturers, in consideration of the apartments relinquished by them in the said College; and 50*l.* by the Mercers' Company, in lieu of their apartments; the first payment to be made 25th December, 1768."

The four Lectureships,—Divinity, Astronomy, Music, and Geometry,—appear from this Act to have been placed, either by direct arrangement or by custom, under the Lord Mayor and Corporation; and the other three,—Law, Physic, and Rhetoric,—under the Mercers' Company; or at least, that the respective stipends were so paid by them. The Will itself (for a wonder!) is compatible with this one arrangement. Whether the "compensation" was adequate or not, need not be discussed here, as referring to *that* period: but the great increase in the value of property certainly renders it inadequate now. The crying wrong is, that the 50*l.* per annum, left as stipend to each professor, *ought to be now* about 475*l.*, if the Corporation had carried out the will of Sir Thomas Gresham, "*according to the true intent and meaning thereof.*" In fact, the merchant Prince, had he endowed his College in our day on the same scale, would have endowed each of the professorships with somewhere about *six hundred pounds* per annum. These stipends would indeed, as Ward says of the original ones,* have been "a proper encouragement for persons of the best abilities in the several professions."

The *fifth clause* ordains, "that, in consideration of the great age and infirmities of Henry Pemberton, Doctor of Physick, the present reader in physick

* Mr. Wade in speaking of the City companies, makes the following very pertinent observations:—

"There are eighty-nine Trade Companies, and their total amount of property is estimated at 250,000*l.* per annum. Several of the companies, as the Drapers', the Mercers', and the Goldsmiths', are supposed to be nearly as rich as Christ's Hospital. The greater portion of the funds of the companies, held as their private property, is doubtless the surplus produce of trust charities accruing from a technical error of the donors. If the testator bequeath the *whole* produce of a field, worth in his life-time about 10*l.* per annum to a charity-school, and that field became valuable building ground, let at 500*l.*, the *whole* of that 500*l.* must go to the school. Such is the decision of the courts. But if the testator, not dreaming of this increase in the value of landed property, said in his will: 'I have a field worth 10*l.* per annum; I bequeath 5*l.* to school A., and 5*l.* to school B.;' and after his death this field rises in value to 500*l.*, then the master and wardens, the trustees of the testator, claim the right of keeping for their own uses the difference between the 10*l.* and the 500*l.*; the testator having neglected to provide that the *whole* produce of the field should be divided between the two schools.

"St. Paul's School, which was left in trust to the Mercers' Company [the *Mercers'* Company again!] affords an illustrative example. In the year 1524, the estates left by Dean Colet produced 122*l.* a year. At the time of the inquiry by the Charity Commissioners, the same estates produced 5,252*l.* Notwithstanding this increase of income, the company have not increased the number of scholars on the foundation. They still adhere to the old statutable number of 153. That number is said to have been adopted by Dean Colet, because it answered to the number of fish taken by St. Peter (John xxi. 11.) But in other matters they are lax enough in observing the ordinances of the founder; *just so many and so much of them are observed, as suits the interest and convenience of the managers.* On this principle, the high master's salary of a *mark* a week [34*l.* 13*s.* 4d.] has been interpreted to mean upwards of 613*l.* besides gratuities; and the second master's salary of 6s. 8d. [17*l.* 6*s.* 8d.] to mean 300*l.* Neither are they more consistent in continuing to restrict the instruction of the school to the acquisition of Greek and Latin. Dean Colet contemplated no such limitation when he said '*desiring nothyng more thanne* EDUCATION, *and bringing uppe children in good manners and literature.*' Without deviating from the literal expression, education might be interpreted to include other branches of learning besides an acquaintance with the dead languages."—(*Black Book of England*, p. 361.)

Had the earlier Gresham Professors consented to convert the college into a school, in which the sons of the richer and more influential citizens could have obtained gratuitous education for their sons, as in St. Paul's, Merchant Tailors', and Christ's Hospital, the foundation might possibly have been preserved like those schools. To the poor man's son, as a poor man, these schools are not open; and it is only by bribe or interest that a boy can be placed on any of these foundations. The Corporation could not discover the *uses* of such a foundation as the Gresham, and hence have exerted themselves to nullify, as far as they dare, the very express regulations of the founder, and have succeeded in nullifying all its benefits except the "hat of patronage" to the sinecure chairs,

in the said College, and his long residence therein," [he was appointed May 24, 1728], the Mercers' Company shall pay him "a further additional sum of 50*l.* per annum for and during the term of his natural life, free and clear of all taxes and deductions whatever."

Dr. Pemberton died in 1771, aged 77.

The *sixth clause* enacts, that the City and Mercers' Company "do and shall from time to time, and at all times hereafter, *find and provide sufficient and proper place or places* for the seven professors, and all succeeding persons to be chosen, nominated, and appointed, for the reading the Lectures in Divinity, Astronomy, Musick, Geometry, Law, and Rhetoric, to read the same in accordingly; and also like sufficient and proper place and places for the habitation of the eight almsfolks now or hereafter for the time being."

The "sufficient and proper place" provided in accordance with the provisions of this Act, was—*a spare loft over the Royal Exchange!* "It is a fact," says Mr. Burgon, in his interesting and researchful "Life of Sir Thomas Gresham" "that at the destruction of the Royal Exchange in 1838, *few persons knew where the lectures were delivered; or to speak more truly, whether they were ever delivered at all,*" (vol. ii., p. 524.) Had he said positively that they were not delivered at all, he would have been literally accurate as respects a great number of years.

To the spirited indignation expressed by Mr. Burgon, and his urgent appeal to the corporation, we are indebted in no small degree for the "heap of stones in Gresham-street" which encase the "Lecture Theatre," (as it is somewhat pompously styled,) which forms the present substitute for Gresham College. But of what use is this theatre, whilst the public cannot attend the lectures? and whilst lecturers are appointed in the way we have described, is it likely that the public will attend them, even though the time* should be made more convenient?

The *seventh clause* enacts, that the City and Mercers' Company shall "pay to the Receiver-General of the Excise, *within one month, the sum of* 1,800*l.*, *towards the charge of pulling down the College and building an Excise-office.*"

Upon this clause we have already remarked, as being equivalent to giving a perpetual annuity of 90*l.* to the Government!

The *eighth clause* is a very sweeping one; it virtually compels the owners of any other property which the Excise-office may require, to sell it for that purpose. It contains, however, only the usual provisions of such a case; but is at the same time a fair specimen of legislative and legal verbosity.

The *ninth clause* merely relates to the Excise-office; and the *tenth* reserves all rights anterior to those by which the Corporation and the Mercers held their title, in favour of the possessors of those rights.

The *eleventh* (and last) *clause* we give entire. "And whereas in and by the last Will and Testament of the said Sir Thomas Gresham, the Mayor and Commonalty and Citizens of the City of London, and the Wardens and Commonalty of the Mystery of Mercers of the City of London were directed to permit and suffer the seven Persons elected and appointed to read the Seven Lectures in the said Will mentioned, to have the occupation of all the Mansion-house Gardens and other appertenances (now called Gresham College) for them and every of them there to inhabit, study, and daily to read the several Lectures. And whereas in and by the said Will, it is directed, that no Person chosen to read any of the said Lectures should be suffered to read any of the said Lectures after that he should be married, nor should

* Subsequently to our remonstrance in our first article, the following report appeared in the *Times* of July 14, under the head of "Common Council:"

"THE PROFESSORSHIP OF GEOMETRY IN THE CITY.

"A report of the Committee on Gresham affairs was brought up. It stated that a vacancy had taken place in the office of Professor of Geometry, under the will of the late Sir Thomas Gresham, by the death of the Rev. Dr. Birch. It was resolved—

"'That with the view of making these lectures more popular, it would be desirable that they should be delivered in the evening.'

"It was also resolved, upon the motion of Mr. Bower—

"'That no candidate be elected to the vacant Gresham Lectureship who will not pledge himself to deliver the lectures in the evening, if required to do so by the Gresham Committee.'"

We could wish that Mr. Bower, or some of his colleagues, had taken a little more of our advice: and that in addition to fixing upon a more convenient time for lecturing, they had sought out the most able man to deliver those lectures. The essential parts of the reform are yet wanting: but they will come in time.

receive any Fee or Stipend appointed for the reading of the said Lectures: And whereas in pursuance of this Act the said College will be pulled down and taken away, and the *Collegiate Life of the said Lecturers, intended by the said Sir Thomas Gresham, put an end to;* be it enacted by the authority aforesaid, that from and after the passing of this Act, *it shall be lawful to and for the said Seven Lecturers, or their Successors, or any of them, to marry, notwithstanding any restriction in the said Will;* and each and every of the said Lecturers and their Successors shall, notwithstanding their being married, be suffered to read their said several Lectures after they shall be married, and shall be entitled to receive the Fee or Stipend appointed for the reading of their said several Lectures; and the Mayor and Commonalty and Citizens of London, and the Warden and Commonalty of the Mystery of Mercers, and their Successors, shall not be deemed guilty of any misapplication of the Sum or Sums of Money as they shall have paid in Fees or Stipends to the said Lecturers, though married; any Restriction or Limitation in the said Will contained notwithstanding."

It is a curious circumstance that of all the *endowed professorships* in this country, the Gresham is the only one in which celibacy is a condition annexed to the office. It might, possibly, have been a compliment, or out of deference to Queen Elizabeth's known aversion to men who had "committed the unpardonable sin of matrimony." It is, however, more in keeping with the idea of the founder's *intending the endowment in the light of seven fellows and college-tutors, after the manner of the college in which he himself was educated.* The term "professor" is nowhere used* in the Will itself; and as the institution is so strictly collegiate in its provisions, we cannot but look upon the parties who framed the provisions of the "tripartite deed" as having totally misunderstood the founder's real intentions. Whether for better or worse can only be judged of by the results; and these are:—that in our Universities the endowments are preserved and (if not uniformly so used) are at least available for the "increase of learning"—whilst the Gresham endowment is all but annihilated, and for a century and a half has done next to nothing for that purpose, and is now doing absolutely nothing. Had Sir Thomas Gresham constituted the college itself a corporation independent of all others, there is no doubt that its funds would have enabled it to extend its usefulness further than he himself contemplated; and other persons witnessing this, would have founded other and similar colleges, so that instead of London being the only capital in Europe that does not possess a University, it might ere now have proudly pointed to the most noble one in existence. We grant that the English Universities, self-governed as they are, are not models of purity—very far from it: but still they are perfection itself compared with the Gresham. The fact is, that the benevolent knight placed the trust in the hands of a corporation whose interest it was to crush, oppress, and annihilate it, for the sake of appropriating its funds. The citizen had no sympathy with literature and science; and hence it was a grave mistake to place its funds in the care of persons who could scarcely fail to abuse them. With this act the college was formally dissolved; and the "collegiate life" of its professors "put an end to."

It seems, however, that the citizens had been in the habit of looking upon matrimony only as an inconvenience whilst the professors lived in college; or in other words, that though marriage did not dement their professors, it would be indiscreet to congregate seven ladies within the walls of the College—lest they should quarrel with one another, like some seven married denizens in one of the many squalid courts that then abounded in the city! However, fifty pounds a year as compensation, with leave for the professors to take wives and live where they pleased—with a prospect of *at last* being paid their salaries regularly—formed a sufficient temptation to those "seven learned persons" to surrender not only their own personal rights, but the inchoate rights of their successors, and the cause of learning into the bargain. This was very disgraceful on their part, though the disgrace on the part of the City and the Government might be infinitely greater.

* The term, indeed, had not then been "Anglicised."

The spirit which led to the subversion of this College still rules in the management of the contemptible system substituted by this Act. Instead of rendering the paltry sum preserved for its maintenance as effective as it might even yet be for the "increase of learning," the trustees, only a week ago, "elected!" the man who, of all the eligible candidates, had given the least proof of his fitness for the duties of the office.

Here we leave this discreditable subject; certain, however, that the history we have given will astonish our readers, and at the same time confident that our indignation will be shared by every honest man amongst them. Reform must come, and will come!

MR. BAGGS'S DISCOVERIES IN ELECTRICITY.

Sir,—In your last Number was inserted a short account which I gave of the lectures on Electricity delivered by Mr. Baggs, at the Polytechnic Institution. The difficulty of acquiring more than a general knowledge of the departments of science included under the name of Natural Philosophy, renders caution advisable in pronouncing upon the originality of any apparent addition to their details. This caused me to be guarded in my remarks upon the mode of discharging, and the electrometer used by Mr. Baggs, which, although new to myself, might have been already known to more experienced electricians. I must presume that Mr. Baggs is well acquainted with this branch of the subject, and he has since informed me that both the discoveries alluded to are original. Those who can appreciate the value of these discoveries, will be equally anxious with me that the credit of them should be given to whom it is justly due.

I am, Sir, yours, &c.,

JOHN MACGREGOR.

Dublin, July 28, 1848.

SEA-WALLS—SHOULD THEY BE SLOPING OR VERTICAL?

Fig. 5.

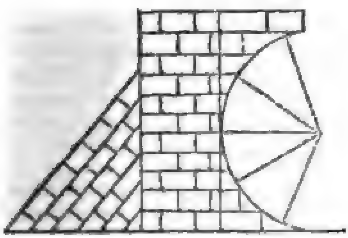


Fig. 1.

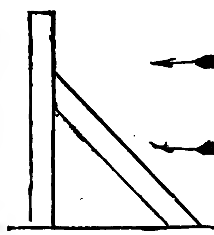


Fig. 2.

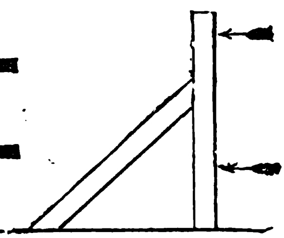


Fig. 3.

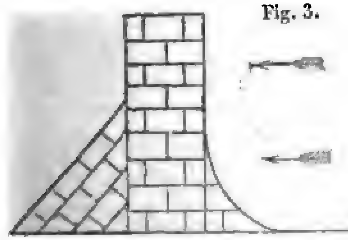
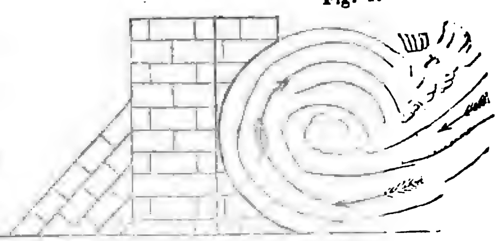


Fig. 4.



Sir,—A perusal of the various letters on the construction of sea-walls from your doubtless able and experienced correspondents, has suggested to me the following ideas, which, if you think worthy of being made public, I shall feel honoured by their insertion in your Journal. I possess no experience in the matter; but ideas from the inexperienced, if suggested by reason, may sometimes

prove useful to those capable of taking advantage of and improving upon them.

In the first place, I think it is pretty clear that the force of the waves and the weight of the water act in a horizontal direction. Then who would oppose a horizontal force, or place the opposing power in the manner shown in the sketch, fig. 1? Would it not rather be more consistent with reason and all the generally understood and accepted principles of offering resistance to an opposing power, to place the beams (supposing for the sake of making myself more clearly understood, the building to be of timber) in the manner shown in fig. 2, where the beam on the angle supports the vertical beam? Again, in the building of buttresses to an edifice, do we build the buttress on the side of the opposing weight or power, or on the opposite side? Do we not support the vertical wall by an opposing angle, on the same principle as exhibited in fig. 2? For these reasons I consider a vertical wall supported by an angle, or continuous buttress, to be stronger than a sloping wall. But why not combine the two, and form a curve as in fig. 3, to break the direct force of the water? Doubtless the recoil of each wave would tend in a great measure to break the force of the following wave. Carrying out this principle, why not continue the curve in the manner described by fig. 4? I imagine by this means you would obtain an almost continuous and opposing current to the force of the waves, without the force of the water being at any time opposed at right angles to the wall. The water being, as I imagine is always the case where sea-walls are erected, agitated to the bottom, the wave will first strike on the curve, and the impetus and weight of water behind will force it up, and again return it, meeting the direct current in the manner indicated by the arrows, fig. 4, without nearly the same strain upon the wall as if opposed at any place at right angles; for if at any time a wave strikes the wall built as I have described, the force will not be directed at right angles, except in a manner and at parts which are most capable of resistance. Thus all the force striking the lower parts of the wall, will, if at right angles, be in the manner shown in fig. 5, downwards, and opposed by the foundation and the supporting buttress; if in the centre the buttress again supports it, and if on the upper part of the wall, the effect will be seen by reference to the same figure to be, rather to raise the wall than to force it inwards, and consequently it will be unsupported by any weight of backwater, but merely the force and weight of the wave itself.

I am, Sir, yours, &c.,
STEPHEN SHARP.

8, Mount-row, New Kent-road,
July 24, 1848.

HODGSON'S PARABOLIC PROPELLER IN HOLLAND.

It is now more than four years since this propeller was patented in England, and some very successful trials made with it on the Thames (see *Mech. Mag.*, vol. xli., pp. 238, 256, 268—xlii., 234.) How it has since fallen into neglect in this country, we know not; but certain it is, that it has, in the meanwhile, attained to high honour among a neighbouring people, and seems likely to supersede with them the use of the screw. We subjoin a translation of the official report made by a commission of Dutch naval officers, appointed to superintend a series of experimental trials of this form of propeller; also a statement of its subsequent performances in his Netherland Majesty's steamship *Samarang;* and, lastly, an estimate of its capabilities as compared with other propellers, deduced from the data as obtained:

1. *Official Report of Commission of Dutch Naval Officers on Hodgson's Steam Propeller.*

In pursuance of the order of his Excellency, the Minister of the Navy, sundry experimental trips were made with his Majesty's steam-ship *Samarang*, in presence of the undersigned parties, who were united in a commission for that object, in order to compare several different submerged propellers.

Of the said experimental trips which were made in smooth water, and at the same draught, between Rotterdam and the Brill, the Commission has drawn up the following results, in which the statements express the averages of the observations—

Experimental trip on the 11th November, with a four-bladed screw:

The distance was 7·43 German miles per watch (or knots per hour,) at 36⅝ double piston strokes per minute, under a steam pressure in the boiler of 5¼ Eng. lbs. per square

Eng. inch. The barometer gauge of the condenser indicated 26½ Eng. inches, while the atmospheric barometer stood at 29¼.

A light top-gallant breeze from S. S. W.

Experimental trip, on the 13*th November, with the Parabolic Propeller of Mr. Hodgson:*

Rate, 7·77 knots; 37⅝ piston strokes; steam, about 6 lbs. Condenser barometer, 26½ inch. Atmospheric barometer, 29$\frac{7}{16}$. Wind N. N. W., blowing a light top-gallant breeze to a reefed topsail breeze. Squally weather.

Experimental trip on the 16*th November, with a two-bladed screw, the course and centre line of which is the same as the four-bladed one:*

Rate, 7·42 knots; 41¼ double strokes; steam pressure in the boiler, 6$\frac{7}{8}$ lbs. Barometer of condenser, 25⅞ inches. The atmospheric barometer, 29½. Wind N. N. W. from a variable top-gallant breeze to a calm.

Rotterdam, the 29th November, 1847.

(Signed) The Naval Lieutenants,
J. Welterbach.
J. L. van Florensteyer.
D. L. Wolfson.

The Engineer in the Steam-boat Service,
D. van den Bosch.

2. *Statement of performances in the* Samarang *in Voyage to the East Indies.*

In consequence of the preceding Report, the screw was permanently superseded in the *Samarang* by the parabola (Nov. 1847,) and the vessel proceeded to sea to join the Dutch squadron at Batavia. The following extract from the Report of the Commander will suffice to show how she behaved on the passage out:

"*Under steam alone.*—With a light breeze, and going with the wind, her speed was 6¾ and 7 knots, with steam of not more than 3 lbs., the throttle-valve one-third open, and 31 double piston strokes."

3. *Comparative Estimate.*

As the power exerted is in the ratio of the cubes of the velocities, and as 31 strokes of the engine with 3 lbs. steam was exerted, whilst at Rotterdam the power was 38 strokes of the engine with 6 lbs. steam, it follows therefore, by calculation, that if, with the former power exerted, the mean speed was 6·875 knots, with the latter it would have been 9·27 knots: and this agrees nearly, allowing for the state of the weather, with the speed attained at Rotterdam, where the maximum was 8·5 knots, blowing hard with the wind a-beam. The effect of this may be appreciated by the remark of the authorities at Woolwich, on a trial with the screw on the *Rattler*, viz.—"A fresh breeze a-beam, which must have retarded the vessel to some extent."

In estimating the slip of the propeller by comparison with the result of the best effort of the screw on her Majesty's steam-ship *Dwarf*, the following statement, in juxtaposition, is very conclusive:

	Parabola.	Screw.
Diameter of propeller	5 ft. 11 ins.	5 ft. 8 ins.
Pitch of ditto	7.6 ft.	8 ft.
Revolutions of engine per minute	31	30.124
Ditto of propeller ,,	114.452	155.441
Ratio of revolutions of propeller to the engine	3.692 : 1	5.16 : 1
Speed of propeller per hour	8.578	12.264
Ditto of vessel ,,	6.875	8.939
Slip of propeller per cent.	19.854	27.112, or 7.258

per cent. more slip of the screw, with very nearly 43 per cent. higher velocity of propeller, and steam pressure 11.2 lb. to that of 3 lb. per square inch.

The following is a comparative statement of the experiments at Rotterdam:

	2-bladed parabola.	4-bladed screw.	2-blad. screw.
Diameter of propeller	5 ft. 11 ins.	6 ft.	6 ft.
Pitch of ditto	7.6 ft.	8	8
Revolutions of engine per min.	37.833	36.833	41.25
Ditto of propeller ,,	139.679	135.987	152.295
Ratio of revolutions of propeller to the engine	3.692		
Speed of propeller per hour	10.469 knots	10.728	12.015 k.
Maximum speed of vessel do.	8.500	7.875	8.000
Slip of propeller per cent.	18.82	26.60	33.42
Difference of slip in favour of the parabola, as compared with the 4-bladed screw	7.78		

And with the 2-bladed screw, 14.60 per cent., under adverse circumstances of wind, as the following extracts from the official report show:

Parabola:—" Wind N. N. W., blowing a light top-gallant breeze to a single-reefed top-sail breeze. Squally weather."

4-bladed screw:—" A light top-gallant breeze from S. S. W."

2-bladed ditto:—" Wind N. N. W., from a variable top-gallant breeze to a calm."

TO OBTAIN PRINTS FROM SEALS, COINS, OR MEDALS.

Sir,—The method of obtaining on paper a kind of printed impression of plants, particularly of leaves, is pretty well known, but I dare say is little used, being rather more curious than useful. It is a long time since I first employed similar means for transferring to paper, printed impressions of seals, coins, and medals, the particulars of which I now transmit you for the general benefit of your readers.

The above sketch will give a very accurate representation of an impression, as obtained from a wax seal, by my process, previous to being touched up with a camel-hair pencil and Indian ink, to do which requires a very moderate share of artistical skill. The impressions from coins, &c., are even more curious and interesting, particularly when new and sharp, as then every letter comes out well defined. In the above specimen, the seal having been rather deep cut, the lines on the raised surfaces are lost in the print, and therefore require more after finish; however, even then, it is very clear that a vast deal of labour has been saved. I have no doubt that seal engravers may profit by this means of obtaining correct flat outlines; and to collectors of coins, seals, &c., it will be a source of interest and amusement.

Prepare a sheet of strong wove letter-paper, by oiling it with sweet oil, rubbing off any superfluous oil with soft paper or cotton. Then take a small oil lamp, adding to the oil in it, one or two tea spoonfuls of spirits of turpentine; light it, and it will give a very smoky flame. Hold the oiled sheet of paper with both hands, bring it close on to the flame, nearly touching the wick, and by keeping it in motion backwards and forwards, the whole surface may be blackened over, without risk of inflaming the paper. When thus prepared, proceed to knead up a little *new* bread in the palm of the hand, until it is like, and about the consistence of, putty; work it to a pyramidical shape, with the base the size of the coin, seal, &c., for which it is intended, then by pressing it with the thumb of each hand, a good impression will be obtained (commonly called a *bread seal*). Take this paste die in one hand, and dab the face of it carefully on the blackened side of the prepared paper, in several places, according to the depth of shade wanted, which a little experience will regulate, then press it gently and evenly on a sheet of drawing-paper, with the fingers of one or both hands, until a complete transfer is made. In some cases the bread-seal or die is best made by pressing a wafer of the paste equally over the surface of the coin or medal, and taking it off with the small pyramidical formed bread, as at first directed.

I have only to observe in concluding, that the oil of turpentine is an improvement to the lamp, for giving intensity to the black paper, and that the bread-seals must always be used while new and soft, and may be worked over and over again the same day, but are of no use the day following.

I am your obedient servant,

H. D.

London, July 22nd, 1848.

EARL TALBOT'S NEW BRIDGE AT SHIRLEYWICH—ERECTED ON THE PLAN OF MR. REMINGTON.

(From the *Staffordshire Advertiser.*)

We have much satisfaction in bringing under the notice of our readers a work, in our own immediate neighbourhood, which, though of small dimensions, is a great curiosity in its way, and a vast triumph of scientific ingenuity and engineering skill. We refer to a wooden bridge which has just been completed over the river Trent, near Ingestre, on an accommodation road of Earl Talbot's, leading from Ingestre to Shirleywich. The architect is Mr. J. R. Remington, a gentleman from Alabama, in the United States of America, of several of whose inventions we have before had occasion to speak.

This bridge is remarkable for the length of its span, about 150 feet, and for the diminutive dimensions of the timber used in its construction. It will almost appear incredible to our readers when we state that the six stringers, or beams, which support the planks forming the floor of the bridge are but five inches square at each end, and gradually diminish in size until at the centre they are only 2¼ inches, their length being, as already intimated, 150 feet. The stringers are formed of pieces of oak timber, each about 20 or 25 feet long, attached together by the method technically known as "scarfing." The abutments consist of oak posts, 6 inches square, and 15 feet long, sunk 5 feet in the ground, projecting outward at a considerable angle, and firmly clamped together with iron.

Mr. Remington's own language shall be employed in describing the principle on which the bridge is built: "The great principle sought to be proved in this bridge (says Mr. R.) is that a beam of timber—of whatever size, shape, or length—lying horizontally and resting at each extremity on abutments, is as strong, and will require as much weight on the top of it to break it as it would take to break the same piece when pulled longitudinally in the direction of the fibre." We apprehend that Mr. Remington's meaning would be better understood if he had said that the principle consists in the longitudinal power of timber being applied in a curvilinear form, by which every portion of the material is brought at once into play, and supports an equal share of the strain. Instead of springing from the abutments as an arched, or resting upon them as a horizontal bridge, the stringers may be said to hang or be suspended from the piers—thus bringing the principle of the longitudinal bearing into action.

We understand that many practical men to whom the principle was explained doubted in the first instance its applicability to a bridge of this size, but they are now willing to admit its complete success. That success, indeed, is demonstrated. The bridge is now in use. We have seen several carriages pass over it, and have ourselves driven across it. There is a vibratory motion when anything passes along the bridge; but there is scarcely any perceptible deflection; and we cannot but express our own conviction of the complete triumph of this novel and most extraordinary system of bridge building.

The stringers curve gracefully upwards from each abutment, and then gradually bend in a curvilinear direction downwards to the centre of the bridge; the lowest point being 24 inches below the level of the abutments. The curves near to the abutments are designed more for beauty than for strength; but we understand they are indispensable in faulty foundations, which is the case in the present instance. There is a hand-rail on each side of the bridge, attached to the floor by trellis-work, and as the hand-rail is of considerable strength, and is fixed to the abutments in the same mode as the stringers, it adds materially to the security and solidity of the bridge.

The main advantage of this description of bridge is its *cheapness*. The cost of the structure which we are describing is only about 200*l.*; whereas a bridge to accomplish the same purpose, built on any other plan, would have required an expenditure of many thousand pounds. Another advantage is that such a bridge can be erected in

situations where any other wooden bridge would be impracticable. A third advantage is that the span may, as we are informed, be extended ten times as far as any wooden bridge ever yet constructed; and it may be added that the inventor is of opinion that such bridges will be more durable than those of any other make.

We have introduced at the head of this article an engraving representing the bridge; though it can scarcely be said to convey an adequate idea of this extraordinary structure: the great length of the bridge and the very small size of the stringers precluding the possibility of representing its proportions in a limited space on the proper scale.

Although many foot bridges have been erected on this principle in America, and one in the Surrey Zoological Gardens, yet this is the first instance, we are informed, of a bridge of this construction being built for carriages. Earl Talbot having satisfied himself of the feasibility of the plan, instructed Mr. Remington to build the bridge: thus affording another proof of that enterprise and zeal for improvement of which his lordship's estates afford so many conspicuous and successful examples. His lordship and family have frequently used the bridge, and are much gratified with the success which has attended the experiment.

We may state, in conclusion, that such has been the expedition used in the erection of the bridge that six weeks ago the timber of which it is constructed was growing.

PREPARATION OF IODIZED PAPERS BY ONE SOLUTION ONLY.

Sir,—For a considerable length of time I have employed an expeditious method of preparing iodized papers for the calotype and other photogenic processes, to the advantage of which I now take an opportunity of directing attention.

Having observed that the double iodide of silver and potassium—one of a class of salts very slightly noticed by chemical writers—is decomposed by water, with precipitation of the iodide of silver, I anticipated a similar result with paper caused to imbibe its solution. To ascertain this, a slip of paper, washed over with a solution of the salt (yclept the argento-biniodide of potassium), was dried and immersed in water. A beautiful uniform surface of iodide of silver was immediately obtained, the iodide of potassium being dissolved out by the water. We thus possess a mode of procuring iodized papers by a single wash, ready to be submitted to the intended operations.

In preparing the paper for use, after having received the wash, it must be gently, but perfectly, dried before immersion in water, to enable it to retain the deposited iodide, as this would plainly be washed off if its compound were presented in a fluid form. Again, complete removal of the liberated iodide of potassium is necessary; otherwise, on drying, it might acquire sufficient strength to recombine with the precipitate. It is easy to avoid this, by placing the paper with the coated side downwards on a surface of water. A few minutes suffice for its abstraction by the water, from which it may be recovered, if desired, by filtration and evaporation.

The double iodide of silver and potassium is easily prepared. Nitrate of silver is to be precipitated by iodide of potassium; the iodide of silver thus formed, when washed and dissolved to saturation in a strong solution of iodide of potassium, gives the salt in question. A shorter process is the following: precipitate the nitrate by the iodide, continuing its addition till the precipitate is re-dissolved. The precipitant should be added in small quantities at a time, accompanied by stirring. Thus prepared, the salt is contaminated by nitrate of potash, which, however, is no great detriment to its use. The solution of iodide of potassium which I have employed to take up the silver, contained about 50 grs. to the oz. The solution of the double iodide cannot be diluted with water beyond a certain extent. If excess of water be added to it, or used to dissolve its crystals, decomposition ensues. When this occurs, evaporation will cause the precipitate to be re-dissolved, by concentrating the alkaline iodide.

I find that the most perfect distribution of this and other solutions over the paper is effected by using a glass stirring-rod or tube. The paper being placed at the edge of a table, so that the rod may project beyond it for convenient handling, a sufficient quantity of the solution, taken up by a pipette, is made to trickle over its surface, in a line towards the operator. The rod, which should be perfectly straight, to touch the paper throughout its length, is then applied in the same direction, and the solution spread evenly by right and left movements, with some

degree of pressure. If a tube be employed, of course the pipette may be dispensed with, since on dipping it into the liquid, and closing the upper end, it may be made to withdraw the quantity required. This plan is more economical than the use of brushes, which, besides requiring frequent cleaning, are soon more or less damaged by the various solutions employed, and scatter their hair over the paper. A smooth glass rod will not roughen the surface of the paper, but tends somewhat to an opposite effect. It permits, also, the application of a determinate quantity of the liquid, which is a difficult matter with brushes, from their power of retaining fluids. It should be as long as one of the sides of the paper over which it is to be passed.

I am, Sir, yours obediently,

C. J. JORDAN.

July, 1848.

THE CORNISH STEAM ENGINE AND MR. BOURNE'S STRICTURES.

Sir,—There are two works before the public intended as books of instruction to engineering students, viz., "A Treatise on the Steam Engine," by Mr. Bourne, and "A Catechism,' by way of supplement. I have been somewhat amused at the way in which the "Cornish Engine" is treated in these works, and I would beg a small space in your pages to give the ingenious author a little advice which may be of service to him in his future publications: viz., before he attempts to describe any machine, to endeavour by all means to see it at work, and not trust to drawings and descriptions given by other people, for fear of being hoaxed.

It is evident Mr. Bourne could never have seen a Cornish engine, otherwise he would not have made such mistakes, —a writer whose talent and learning are so obvious throughout the rest of the work, where algebra from simple equations up to the calculus is scattered with a most profuse hand (I confess I can't always follow him in these things; yet of a surety they give the book a very learned *appearance.*)

In page 166 of the "Catechism," after telling us that the centrifugal pump threatens to supersede pumps of every other description, Mr. Bourne says, "the single-acting engine is a remnant of engineering barbarism, which must now be superseded by more compendious contrivances." I must say I feel great curiosity to see the "compendious contrivance" that is to supersede the Cornish engine. Mr. Bourne says he has a substitute for the pump, and when he has a substitute for the engine I hope he will lose no time in giving it to the public.

I always had an idea that, other things being equal, the engine that did the most work with the least quantity of coals was the best engine; but Mr. Bourne thinks otherwise, for in page 48, he shows that the Cornish engine works with less coals by 3 or 4 lbs. per horse power, so that if the water were pumped up by them merely to work one of "Whitlaw and Stirrat's water wheels," the power would be given out by them more economically than by the ordinary rotative engine. And I have no doubt, Mr. Editor, before Mr. Bourne has completed his "compendious substitute" they will be applied for that purpose in cities where small power only is required for domestic purposes, &c.

But after reperusing his description of the Cornish engine, I fancy I can tell what makes him call it "a remnant of engineering barbarism." In page 169 of the "Treatise," and page 157 of the "Catechism," after describing the cataract, he says "and the plunger (*i. e.* the cataract plunger) in its descent opens the injection valve, which causes the engine to make a stroke. If the cock of the cataract be shut, it is clear the plunger cannot descend, and as in that case the injection valve cannot open, the engine must stand still; but if the cock be slightly opened, the plunger will descend slowly, and the engine will make a gradual stroke, as it obtains water necessary for condensation." Now, if any engine upon earth works like that, it is a remnant of barbarism sure enough! Somewhere also the author says, that "a good Cornish engine should be capable of going ten strokes per minute or one stroke in 10 minutes." But the idea of regulating the speed of an engine between those extremes by the injection cock, is too rich! I am sure whoever furnished Mr. Bourne with this description was guilty of a most barbarous experiment upon our author's credulity. I need not tell your readers that the speed of the engine is

regulated by the cataract opening the steam exhaustion and equilibrium valves, and *not* the injection valve.

I am, Sir, yours respectfully,

A CORNISH MINER.

Hayle Foundry, Cornwall, July 17, 1848.

BREAKWATERS—SHOULD THEY BE SLOPING OR VERTICAL?

Sir,—I have examined at full length the Report of the Dover Harbour Commissioners, with the protest of Lieutenant General Sir Howard Douglas against their decision, and also the several remarks which have appeared in the pages of your Magazine; but I have still to be convinced that that great national undertaking, the Plymouth Breakwater, or in other words, the sloping breakwater, has proved a failure, and that the vertical wall is best calculated to resist the force of the waves, or the mighty swell of the ocean.

The main point at issue is, whether or not the waves of the sea are impelled horizontally by the force of the wind?

It seems to me that, on the solution of this question, the whole discussion depends: if the waves of the sea *are not impelled* horizontally by the force of the wind, then there remains but the vertical or oscillating motion to contend with; and if such be the case, no one will dispute but that a vertical wall is sufficient; if, on the other hand, the waves of the sea *are impelled* horizontally by the force of the wind, then I think there ought to remain but little doubt that a vertical wall would be a dangerous and unwarranted experiment.

Are the waves of the sea impelled horizontally or not by the force of the wind?

The best answer to this question is, by referring your readers to the valuable paper which appeared in your pages a few weeks back—"Experiments on the Force of the Waves of the Atlantic and German Oceans. By Thomas Stevenson, Esq." During the 23 months these experiments were carried on, the greatest force of the waves registered by the marine dynamometer was upwards of 3 tons per square foot; but was this by a vertical or a horizontal propulsion? The words of the Report shall answer the question:—"Now, when we consider that the hydrostatic pressure due to a wave of 20 feet high, is no more than about half a ton on a square foot, we see how much of their force the *waves* owe to their *velocity*."

If the waves of the sea are not impelled horizontally by the force of the wind, how do you account for the onward movement of pieces of wood or sealed bottles thrown overboard ship, the latter having been found often stranded, or picked up at sea a considerable distance from the spot where they were originally dropped?

One of your correspondents says, very truly, "Of what use would a floating breakwater be, if the action of the waves were only vertical?" I conceive in such a case that the sea would be as rough on one side as the other; yet such things as floating breakwaters have been proposed, and perhaps used.

I am not now taking the subject up mathematically, that having been already done in a previous paper of a correspondent, who combats Professor Airy's opinion, that the waves of the sea are caused by vertical oscillation only: I am merely reviewing facts, as they have occurred to me, which bear upon the discussion.

If the waves of the sea were caused by vertical oscillation only, we should never hear of damages occurring to piers with vertical faces by the action of the waves, or the upheaving of large masses of rock from their original position on the sea coast, which, though once presenting quite a perpendicular front, have gradually, through lapse of time, been brought by the action of the sea to present a *sloping* breakwater, which, receiving the full force of the waves, thus protects the face of the rock behind, laid open by the recent rupture.

On referring to the Report of the Dover Harbour Commissioners, I find the following names appended of those in favour of a vertical wall:—Professor Airy, Professor Barlow, Major-General Sir J. Burgoyne, Sir Henry de la Beche, Mr. Hartley, Major-General Pasley, Captain Vetch, M. Reibell, Mr. Brunel, and Mr. Bremner. Of these there are three whose opinions are founded entirely on theory, three the opinions of military engineers, and there remain just four, whose opinions are founded entirely on practice; but Mr. Brunel was never examined, and Mr. Hartley's opinions are but vague and undecided.

Of those whose opinions were *decidedly* in favour of a sloping breakwater, there were Sir John Rennie, Mr. George Rennie, Mr. Cubitt, Mr. William Stuart, and Mr. Alan Stevenson, all of whom gave their most decided disapproval of any attempt to build an upright wall in Dover Bay. *Their* opinions are founded upon a lengthened period of the most practical knowledge of works of *this* kind. *Their* practical professional knowledge is discarded for the opinions of those whose views are chiefly founded on theory and conjecture. They not merely disapproved, but condemned any attempt to erect an upright wall. The names of Lieut.-General Sir Howard Douglas and Sir William Symonds must not be forgotten; they were both members of the Commission, and the oldest, the former of whom, after the unexpected decision of the majority of the Commissioners, drew up and presented a lengthened protest against it, in which he most successfully reviews the opinions of his opponents, leaving no doubt in my own mind, and I hope in the minds of many others, of the utter fruitlessness of ever attempting to build an upright wall in such an exposed a situation as that of Dover Bay, in seven or eight fathoms depth of water.

I remain, Sir, yours, &c.,

T. B.

Manchester, July 28, 1848.

VERTICAL SEA-WALLS—MR. ROBERT STEPHENSON'S OPINION.

Sir,—In the discussion on sea walls in your Magazine, whether they should be sloping or vertical, great attention should I think be paid to the note, p. 567, which relates the opinion of Mr. Robert Stephenson on this subject.

I remember being at the Institution that particular night, and having seen the sea wall near Penman Mawr, when in the course of construction, I took great interest in what that eminent engineer said. After describing the effect of the storm on the walls as erected by him, he concluded with these words, as near as I can recollect, "And from what I have seen, I am determined never to construct a vertical sea wall again." Such words, from such an engineer, are of the utmost importance.

I am, Sir, yours, &c.,

S. S. B.

GEOMETRICAL PROPOSITION AND DEMONSTRATION. BY THOMAS WILKINSON, ESQ.

Sir,—Allow me to offer to your notice the solution of a geometrical proposition of some importance. If it should be so fortunate as to approach to what you consider a demonstration *ought* to be, I shall feel much obliged by its insertion in your valuable Journal.

Yours respectfully,

THOMAS WILKINSON.

Burley, Lancashire, July 27, 1848.

Proposition.

Let O be any point within, or without, the field of the triangle ABC; OD, OE, OF lines drawn to any points D, E, F in the sides, or the sides produced; and A*a*, B*b*, C*c* lines drawn from the angles parallel to OD, OE, OF respectively; meeting the sides, or the sides produced, in the points *a*, *b*, *c*;—then if *m*, *q*, and *t* be the points where lines from O parallel to the sides cut, A*a*, B*b*, and C*c*, we shall have the following relations:

$$\frac{OD}{Aa}+\frac{OE}{Bb}+\frac{OF}{Cc}=1.$$

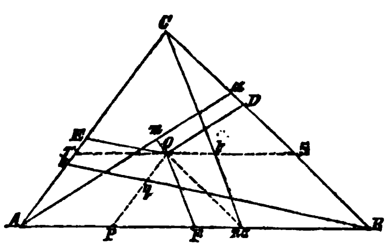
$$\frac{Am}{Aa}+\frac{Bq}{Bb}+\frac{Ct}{Cc}=2.$$

Required the demonstration.

Demonstration.

Case I. When the point O is *within* the triangle.

Fig. 1.



Let ABC be the triangle, and OD, OE, &c., the lines as in the enunciation. Through O draw *mn* parallel to BC; O*p* parallel to AC; and *rs* parallel to AB, cutting C*c* in *t*.

Then since $ma = \text{OD}$, we have $\dfrac{\text{OD}}{\text{A}a} = \dfrac{\text{B}n}{\text{AB}}$.

Also since $bq = \text{OE}$, we have $\dfrac{\text{OE}}{\text{B}b} = \dfrac{\text{A}p}{\text{AB}}$.

And because the triangle $p\text{O}n$ is similar to ACB, and the lines Cc and OF make equal angles with BC and nO, we have $\dfrac{\text{OF}}{\text{C}c} = \dfrac{pn}{\text{AB}}$.

$$\therefore \frac{\text{OD}}{\text{A}a} + \frac{\text{OE}}{\text{B}b} + \frac{\text{OF}}{\text{C}c} = \frac{\text{B}n + \text{A}p + pn}{\text{AB}} = \frac{\text{AB}}{\text{AB}} = 1 \ldots\ldots (a).$$

Again by similar triangles $\dfrac{\text{A}m}{\text{A}a} = \dfrac{\text{A}n}{\text{AB}}$.

$$\text{Also, } \frac{\text{B}q}{\text{B}b} = \frac{\text{B}p}{\text{AB}}; \text{ and } \frac{\text{C}t}{\text{C}c} = \frac{rs}{\text{AB}} = \frac{r\text{O} + \text{O}s}{\text{AB}} = \frac{\text{A}p + \text{B}n}{\text{AB}}.$$

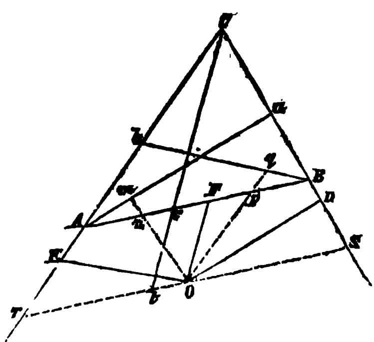
$$\therefore \frac{\text{A}m}{\text{A}} + \frac{\text{B}q}{\text{B}b} + \frac{\text{C}t}{\text{C}c} = \frac{\text{A}n + \text{B}p + \text{A}p + \text{B}n}{\text{AB}} = \frac{2\,\text{AB}}{\text{AB}} = 2 \ldots\ldots (b).$$

Expressions (a) and (b) are the relations required.

Q. E. i° D.

Case II. When the point O is *below* the base of the triangle.

Fig. 2.



Draw the lines as before to meet the sides produced where necessary, as in fig. 2; then it is evident that $\text{OD} = ma$, $\text{OE} = bq$, and we have

$$\frac{\text{OD}}{\text{A}a} + \frac{\text{OE}}{\text{B}b} - \frac{\text{OF}}{\text{C}c} = \frac{\text{B}n + \text{A}p - pn}{\text{AB}} = \frac{(\text{B}p + pn) + (\text{A}p - pn)}{\text{AB}} = \frac{\text{AB}}{\text{AB}} = 1 \ldots\ldots (a').$$

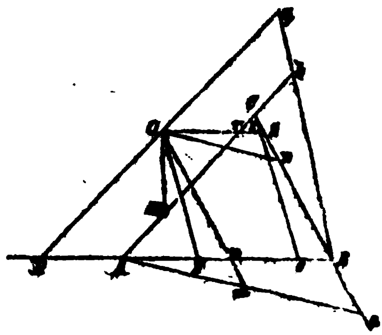
$$\text{Also, } \frac{\text{A}m}{\text{A}a} + \frac{\text{B}q}{\text{B}b} + \frac{\text{C}t}{\text{C}c} = \frac{\text{A}n + \text{B}p + rs}{\text{AB}} = \frac{\text{A}n + \text{B}p + \text{A}p + \text{B}n}{\text{AB}} = \frac{2\,\text{AB}}{\text{AB}} = 2 \ldots\ldots (b').$$

Where (a') and (b') are the relations as before.

Q. E. ii° D.

Case III. When the point O is *beyond* the vertex of the triangle.

Fig. 3.



Draw the lines as before; then in fig. 3 we have $OD = ma$, $OE = bq$, and $OF = tc$.

$$\therefore \frac{OD}{Aa} - \frac{OE}{Bb} + \frac{OF}{Cc} = \frac{Bn - Ap + pn}{AB} = \frac{AB}{AB} = 1 \ldots\ldots (a').$$

$$\text{Also, } \frac{Am}{Aa} + \frac{Bq}{Bb} + \frac{Ct}{Cc} = \frac{An + Bp + rs}{AB} = \frac{An + Bp + Os - Or}{AB} =$$

$$\frac{(An + Bn) + (Bp - Ap)}{AB} = \frac{2\,AB}{AB} = 2 \ldots\ldots\ldots\ldots (b').$$

When the point O is nearest the side BC, by reversing the figure the investigation is similar to the above, and in this case $-\frac{OD}{Aa} + \frac{OE}{Bb} + \frac{OF}{Cc} = 1$; the second expression remaining nearly as before.

Q. E. iii° D.

Cor. 1. If in the general proposition OD, OE and OF be respectively perpendicular to the sides; Aa, Bb, Cc, will also be perpendicular to them, and if we designate the former by p_1, p_2, p_3, and the latter by P_1, P_2, P_3, we shall have $\frac{p_1}{P_1} + \frac{p_2}{P_2} + \frac{p_3}{P_3} = 1$. In this form the proposition is found at page 32 of "Gaskin's Geometrical Problems," and was also proposed by Mr. (now Dr.) Rutherford, in No. 5, Vol. i. of the *Northumbrian Mirror* for January, 1838.

Cor. 2. When the lines Aa, OD; Bb, OE; Cc, OF coincide, we shall have $\frac{OD}{AD} + \frac{OE}{BE} + \frac{OF}{CF} = 1$; and $\frac{AO}{AD} + \frac{BO}{BE} + \frac{CO}{CF} = 2$. The first of these expressions was given by Mr. Higman in the Senate House Problems for 1823, and also forms questions 1169 and 1644 in the *York Courant*. Both expressions are given as an exercise on Transversals in vol. ii. of "Davies's Hutton."

Cor. 3. If through O, the lines FG, HI, DE be drawn respectively parallel to AB, BC and CA, we shall have

$$\frac{FG}{AB} + \frac{ED}{AC} + \frac{HI}{BC} = 2. \quad \text{For } \frac{FG}{AB} = \frac{CF}{BC} = \frac{CE + EF}{BC}.$$

$$\text{Also, } \frac{ED}{AC} = \frac{BE}{BC} = \frac{BF + EF}{BC}. \quad \text{And, } \frac{HI}{BC} = \frac{CE + FB}{BC}.$$

$$\therefore \frac{FG}{AB} + \frac{ED}{AC} + \frac{HI}{BC} = \frac{2(CE + EF + FB)}{BC} = 2.$$

This property was given by Mr. Rawson of Manchester in his solution to question 1644 in the *York Courant*.

Cor. 4. When the lines coincide as in cor. 2, and if, also, AD, BE, CF be respectively perpendicular to the sides of

the triangle, we shall evidently have $\frac{AO}{AD}+\frac{BO}{BE}+\frac{CO}{CF}=2$; where O, A, B, C may be considered as the inscribed and escribed centres of the circles touching the sides of the triangle EFD, and in this form the proposition answers to question 1765 in the *Lady's and Gentleman's Diary* for 1847, which was proposed by Mr. J. W. Elliott, of Greatham. Various other properties suggest themselves, but the above must suffice.

Scholium.—The case of the general proposition when the point O is *within* the triangle, and the points D, E, F in the sides, forms question 6, page 73, of "Gaskin's Geometrical Problems," and though the method of investigation adopted by Mr. Gaskin is totally different from the preceding, it was by considering this question that the discussion of the more general proposition was suggested. The figures necessary to illustrate the corollaries will be easily sketched by the reader.

NOTE ON THE APPLICATION OF WATER TO DIFFERENT KINDS OF FUEL. FROM THE UNPUBLISHED PAPERS OF THE LATE BRIG. GEN. SIR SAMUEL BENTHAM.

The important experiments lately made by Sir Henry de la Beche on coal have surperseded those which had been devised by Sir Samuel Bentham, who had considered it also desirable to ascertain the amount of heat afforded by other kinds of fuel, such as wood, peat, and especially oil, either alone, or together with wood or peat, as those articles are in some places to be procured at a cheap rate where coal is not to be obtained; and, as a sequel to his observations, the following memorandum has been found amongst his papers:

"In regard to all, or most of these different kinds of fuel, there seems some reason to believe that an addition of water may be made to increase the quantity of heat produced by their combustion. Chemical analysis appears in some respects to confirm the experience of persons of various classes. The practice of throwing water on coals is general amongst blacksmiths; the wetting of ashes on throwing them on to a coal fire is the usual practice of housewives; mixing green wood with dry, and wet clay with small coal, has been found advantageous in horticultural furnaces.* Experience has to my knowledge at Derby, and I believe elsewhere, shown the advantage of letting water flow into the ash-pit under the fire-place of a steam-engine. Besides which, a very intelligent agent of Mr. Strutt's in his gas manufactory at Derby, has proved by continued experience, that in burning for fuel the kind of oil obtained from coal in the production of gas, more heat is generated by the addition of water than would be produced by the burning the oil without the water."

It seems proper to add on this subject that Mr. Strutt, of Derby, nearly twenty years ago, at Sir Samuel's request, kindly caused a trial to be made in a common steam-engine fire-place of the effect of placing a trough of water in the ash-pit, and that in this way no addition of heat was perceptible, but a very decided advantage in preserving the fire-bars from rapid destruction.

In correspondence on the subject it appears that Mr. Sylvester conceived that as much heat would be lost in decomposing water, as was likely to be gained by burning the oxygen and hydrogen set at liberty; but the subject seems well worthy of accurate experiment.

PAYNE'S PROCESS FOR RENDERING WOOD FIREPROOF.

On Wednesday last a remarkable experiment was exhibited at the Whitehall Wharf, Westminster, for the purpose of testing the value of Mr. Charles Payne's patent process for rendering wood fireproof; or, to speak more properly, perhaps, for the purpose of showing that Mr. Payne's wood-preserving process, which is already well known to the public, and has been very extensively applied,† is as effectual for the preservation of wood from destruction by fire as from the

* See Transactions of the Horticultural Society.

† Among the structures to which it has been applied are the following:
Houses of Parliament.
British Museum.
Fitzwilliam Museum (Cambridge.)
Conservative Club House.
Hungerford Bridge.
High Level Bridge, Newcastle.
Southampton, East Anglian, Brighton, and numerous other railways.

ravages of insects, dry-rot, &c. Two miniature houses had been constructed, one of ordinary deals well dried, and the other of deals prepared by Mr. Payne's process, and the ground floor of each filled with fire-wood and shavings. Both bodies of fuel were kindled at the same time. The house composed of the unprotected wood caught fire very soon, and in about half an hour was completely consumed; while the Payneized house remained standing nearly as perfect as ever, —the fire in it having gone out of itself, and left only some slight marks of charring on the inside of the boards. The experiment was altogether most successful, and we think we may say, with confidence, did not leave a doubt on the minds of any one of a great number of spectators present (including several of our most eminent engineers and architects,) that it needs only the general adoption of Mr. Payne's process to render our dwellings and other structures henceforth indestructible by fire.

Perhaps, however, a still more striking evidence of the efficiency of Mr. Payne's process in this respect, than that which we witnessed on the present occasion, is the following, which we extract from a pamphlet of testimonials put into our hands:

"Finch Mill, Shewington, near
"Standish, Lancashire,
"13th March, 1846.

"Gentlemen,

"I am directed by Mr. Scarisbrick to inform you that he had recently erected on his property here a building for the purpose of drying and seasoning timber, the rafters and principal beams of which building had been prepared under my superintendence here by your patent process, with a view not only to their durability, but also for protection against fire.

"A large quantity of highly resinous planks and staves had lately been placed in this building for seasoning, and these by some accident ignited during the night, occasioning an extensive conflagration, and burning with terrific fury. The Payneised rafters and beams, notwithstanding the immense heat to which they were exposed, did not communicate or extend the flame, which otherwise must have destroyed the whole of this building, as well as others connected with it, and likewise machinery of great value. Indeed, I have no hesitation in saying that I am quite satisfied from what has happened under my own observation, 'that no house built with wood thus prepared can be burnt down, though it might be partially injured.'

"I am, Gentlemen,

"Your very obedient servant,
"JOHN EVERTH,
"*Superintendent of the Proprietors' Works.*

Messrs. PAYNE and LODER,
"Whitehall Wharf, London."

One of the latest orders received by Mr. Payne's Company, is to prepare the wood for a new convict prison about to be erected at Bermuda, and contracted for by Mr. Peter Thompson, the well known moveable house builder of the Commercial Road. The building is to be 146 feet long, 40 broad, and will consume about 300 cubic feet of timber.

The liquid employed by Mr. Payne (by preference) is sulphuret of barium or calcium. We quote from his specification the following account of his mode of applying it:

"The wood, or other vegetable matter, is put into an air-tight vessel, and the air is exhausted therefrom, by filling the vessel with steam, and then condensing it by injecting some of the solution of the sulphuret, and at the same time applying cold water to the exterior of the vessel. When a partial vacuum has been obtained, the solution is allowed to flow into the vessel from the reservoir containing it, through a pipe furnished with a stop-cock; the stop-cock is then shut, and an air-pump, connected with the vessel, is worked until as perfect a vacuum as can possibly be obtained is produced in the vessel; after which, the stop-cock is opened, to allow the vessel to become filled, or nearly filled, with the solution; it is then shut, and by means of a force-pump a further quantity of solution is introduced, until the pressure on the interior of the vessel amounts to from 110 to 140 lbs. on the square inch; this pressure is maintained for about an hour, and then the solution is drawn off. The vegetable matter is now to be impregnated, in a similar manner, with an acid, or a solution of some substance or substances, in water, which will decompose the sulphuret. If sulphuret of barium or of calcium has been employed, any solution or substance may be used that will unite with the barium or calcium, so that the sulphur may be set free; but the patentee prefers a solution of sulphate of iron; and if the solution of sulphuret of barium or calcium has been prepared, of the strength above mentioned, the solution of sulphate of iron should contain one pound six ounces of the sulphate in each gallon.

"In some cases the vegetable matter is dried after being impregnated with the first solution, and before it is subjected to the action of the second; particularly when the vegetable matter is required to be impregnated with as large a quantity of solid matter as possible."

RECENT AMERICAN PATENTS.

(Selected from the *Franklin Journal* for June.)

IMPROVEMENT IN WHEELS FOR RAILROAD CARS. *Godlove K. Kane.*

Claim.—"What I claim as my invention, is making the spokes which unite the hub and rim of railroad car-wheels, each of a plate, one portion of which is parallel with the axis of the hub, and extending from the hub to the rim, and the other connected with the rim, in a line diagonal with the plane of the wheel, and extending from the rim to the hub, the first gradually diminishing in width from the hub to the rim, and the other gradually diminishing from the rim to the hub, substantially in the manner and for the purpose described."

IMPROVEMENT IN CUTTING CORKS.—*Philip C. Traver.*

The patentee says,—"The nature of my invention consists in cutting corks in the form of a frustrum of a cone, or cylinder, from a sheet of cork (fed by hand or machinery) by means of a cutter fastened to the periphery of a hollow mandrel having a compound longitudinal and rotary motion around a centre or axis of a cylindrical sliding holder, inserted into a corresponding aperture in the mandrel, and bearing upon the sheet of cork, in which hollow mandrel is placed a spiral spring, bearing against the upper end of the holder, the lower end of the holder guiding the cutter at the required angle to give the required taper to the cork."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the before-described mode of cutting corks, by means of the aforesaid combination of the hollow mandrel, sliding holder, centerer, and guide—with the cutter for cutting the cork to the required shape—said cutter having a simultaneous, longitudinal, and revolving motion, produced by the means described, or other more suitable means, operating substantially in the manner set forth."

IMPROVEMENT IN COMBING WOOL.—*C. G. Sargent.*

We extract the following from the specification:—"The nature of my invention consists in attaching the comb teeth to a series of plates that are caused to slide along in front of the cylinder of cards, and a pair of rollers for the fibres to be acted upon, and stripped from the teeth, and then are shifted in a parallel position to slide back to the end from whence they first started, and there shifted back to pass along as at first; a hollow box through which steam or heated air circulates, being placed between the comb teeth and the cylinder of cards, and a little below the points of the comb teeth, for the purpose of keeping the fibres at the required temperature while under operation in the machine."

IMPROVEMENT IN STEAM VALVES. *Henry H. Grame.*

The patentee says, "The nature of my invention consists in the introduction of independent valves in the ordinary 'steam chest for sliding valves,' with means of connecting or disconnecting them to the slide valve, operating, when connected, in such a way as to prevent any further ingress of steam within the cylinder after the piston has passed through a certain part of its stroke, and when disconnected, allowing the steam to work through the whole stroke of the piston."

IMPROVEMENT IN THE EXPANSION JOINT FOR STEAM-ENGINES. *Henry R. Dunham.*

Claim.—"What I claim as my invention is the application of a plate of flexible metal in a steam pipe between two flanches of different diameters, the yielding of which plate shall give sufficient room for the expansion of the pipe, thereby avoiding the necessity of using stuffing boxes, or the ordinary copper hemispherical ring joint for side pipes of steam-engines."

IMPROVEMENT IN AUGERS. *Alfred Newton, L. B. Smith, and E. Sanford.*

Claim.—"What we claim as our improvement and invention, is the making or constructing double or single twist augers, with a gradually increasing length of twist, and consequent gradual enlargement of cavity, from the lower or cutting end to the other extremity of the twist."

IMPROVEMENT IN STEAM ENGINES.—*Charles Galvani.*

The patentee says,—"The nature of my invention consists in combining a rotary engine with an annular furnace, the revolving rim of the engine being heated, so that when water is forced into it, it shall be flashed into steam, which passes round through the cylinder, and thence issues through an orifice on one side at a tangent to the wheel."

WEEKLY LIST OF NEW ENGLISH PATENTS.

James Robertson, of Great Howard-street, Liverpool, cooper, for improvements in the manufacture of casks and other wooden vessels, and in machinery for cutting wood for those purposes. July 29; six months.

George Walter Pratt, of the City of Rochester, State of New York, in the United States of America, gentleman, for improvements in the manufacture of printing ink. July 29; six months.

Richard Abbey, of Slough, Buckingham, brewer,

WEEKLY LIST OF NEW ENGLISH PATENTS.

for improvements in preserving fermented and other liquids and matters in vessels. July 29; six months.

Edward Gribben Wilson, of Bury, Lancashire, tin-plate worker, for certain improvements in the construction of tin drums or rollers used in the machinery for drawing, spinning, doubling, twisting, and throwing cotton, wool, silk, flax, and other fibrous substances. July 29; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
July 26	1518	James Hirst Whitehead	Ilkley, near Leeds	Stove-back.
28	1519	John Phillips	Warwick-street, Belgrave-sq.	Syphon trap.
29	1520	John Joseph Hussey	Hertford-street, Fitzroy-square, carpenter	Portable meat screen.
Aug. 1	1521	Samuel Ward	Lowther Arcade, Strand	Spring clip for candlesticks.
"	1522	John Rock Day and Job Clark	Birmingham / Willenhall	Bolt or fastening.
"	1523	George Harborow	Holborn-bars	A pair of braces.
2	1524	John Smith	Bradford	Corn-mill cylinder brush.
3	1525	William P. Stanley and John Medworth	Peterborough / Crown-street, Walworth-road	Farmers' steaming apparatus.

Advertisements.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co. Dublin; W. C. Campbell and Co., Hamburgh.

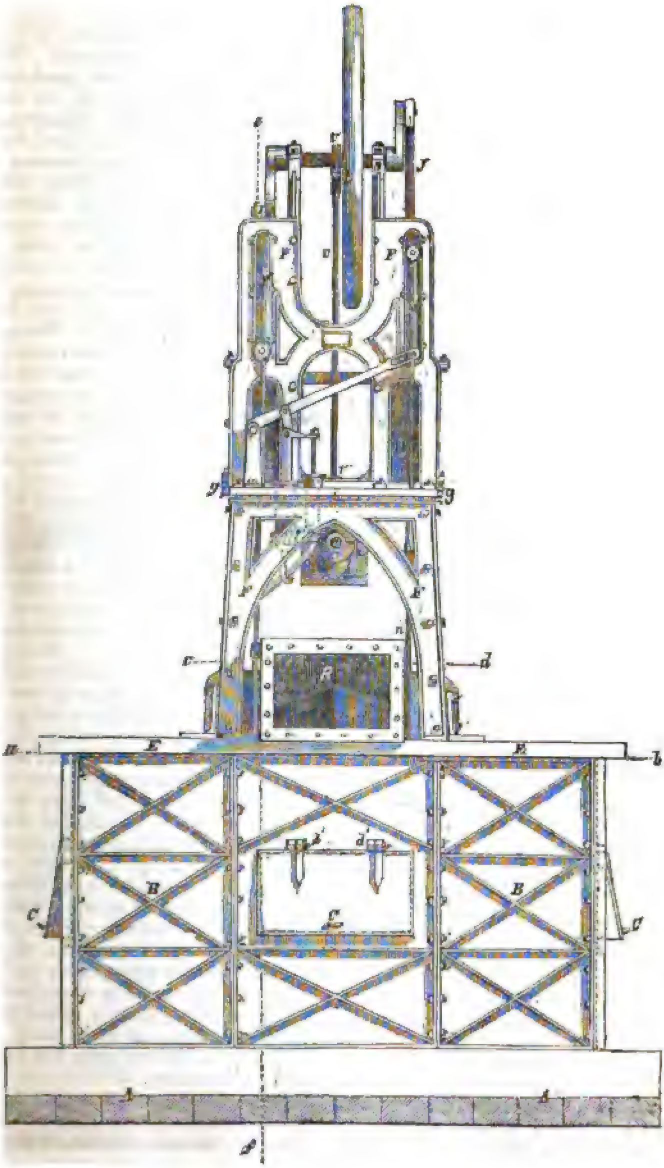
Mechanics' Magazine,
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1305.] SATURDAY AUGUST 12, 1848. [Price 3*d*., Stamped, 4*d*.

Edited by J. C. Robertson, 166, Fleet-street.

WALKER'S HYDRAULIC ENGINE.

Fig. 1.



WALKER'S PATENT HYDRAULIC ENGINE.

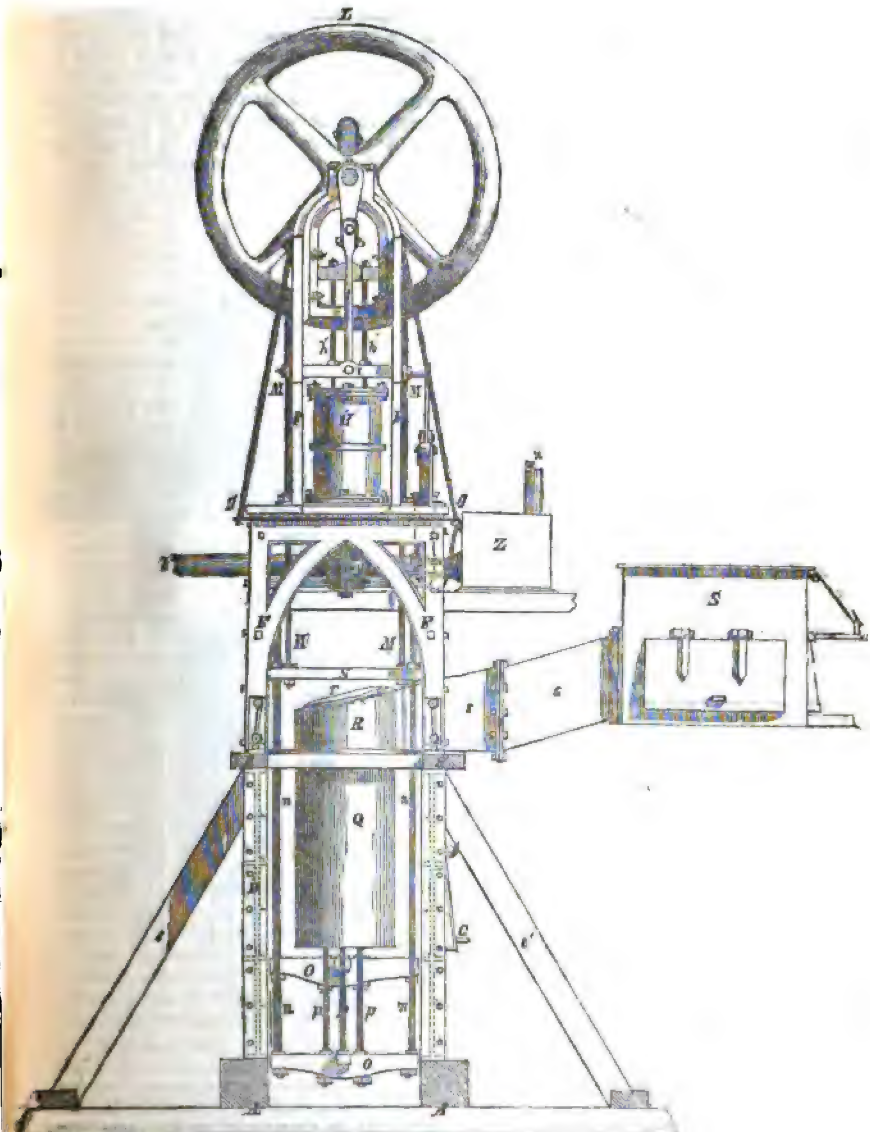
We recently made favourable mention (No. 1301, p. 53) of a new hydraulic engine of extraordinary power which we had seen at work on the premises of Mr. Walker, the inventor, and which has been constructed by him for the drainage of some marsh lands in Norfolk. We now extract from Mr. Walker's specification the following complete description of the engine:

Fig. 1 is a front elevation of the engine; fig. 2 is a side elevation; Fig. 3, a sectional side elevation on the line *e, f*, of fig. 1. A A is a foundation of strong planks, supporting a quadrangular cast-iron well, B B, which is sunk into the ground to such a depth as may be necessary for the purpose required. The well, B B, has three openings, *c c c*, one in front, and one on each side, fitted with sluice doors hinged on their upper edges at *d' d'*, one or more of which can be opened or closed at pleasure. On the upper flange of the well, B B, rests a strong frame of timber, E E, from which stays, *e' e'*, pass down to the foundation timbers and give stability to the superstructure. Upon the frame, E E, are erected cast-iron framed standards, F F, secured to the well, B B, by nuts and bolts passing through the frame, E E. The standards, F F, are in two heights, and upon a flooring at *g g*, there are two steam cylinders, H H, with pistons, each of which is connected by two piston-rods, *h h*, to its respective cross-head I. From a bolt in the centre of the cross-head, I, which works in guides in the side framing of the standards (not shown in the figures) a connecting-rod, J, passes up to a crank on the outer end of the shaft, K, which shaft carries a fly-wheel, L. From the outer ends of the cross-head I, two connecting-rods, M M, pass down to a large cross-head, N N, beneath the steam cylinders; from this cross head two other rods, *n n*, pass down, and are bolted to a cruciform platform, *o o*. Upon the platform, *o o*, are bolted four upright iron rods, *p p p p*, the upper extremities of which support a valved piston, P, hereinafter more fully explained. Immediately beneath the steam cylinders, and supported by their upper flanges, upon the frame, E E, are two water cylinders, Q Q, open at the bottom, and having at top a valve, opening upward. This valve is similar in its construction to those in the pistons afterwards described. Upon the upper flanges of the water cylinders, Q, is bolted a valve-box R, communicating by an exit-main *s*, with what I term a dividing box, S, furnished like the well B, before described with doors on each side, and in front capable of being opened and closed at pleasure. On the top of the valve box are covering plates, *r r*, the removal of which gives access to the cylinder valves. Steam from a boiler is admitted through the induction-pipe *t*, to a slide-valve T, placed beneath and between the steam cylinders, by means of which the steam is admitted alternately to the bottom of each. The slide-valve, T, is worked by an eccentric V, on the crank-shaft K, through the medium of the rod *v*. The steam cylinders, H, are fitted with cones through which the piston-rods, *h*, work; the hot air passing from the upper part of one to the other through the air-tube, *w*, as the pistons alternately rise and fall. After leaving the cylinders the waste steam passes from the slide-valve, T, along the eduction-pipe, *z*, through the water-box, Z, whence it passes into the pipe, z^2, which may be led into a chimney or other convenient outlet. The cold water raised by the pump, b^2, flows into the upper part of the water-box, Z, and into the tubes which descend nearly to the bottom thereof where it becomes heated (by the spent steam passing through the box,) nearly, or quite to the boiling point, in which state it is forced into the boiler by the feed-pump, a^2.

Figures 4 and 5 are enlarged representations of the piston and valves; fig. 4 being a plan, and fig. 5 a sectional elevation thereof. This valve consists of a number of cast iron bars forming a sort of grating strengthened on the underside with cross bars, and having bosses to receive the screwed ends of the supporting-rods, *p p*. The upper surfaces of the bars are ranged in pairs on two alternate levels, the edges of the openings being formed into circular seatings, in which are laid lengths of iron tubing plugged with wood, which close the openings between the bars and form a water-tight joint in a downward direction, but open freely upward. To keep the lengths of tubes in their places endways, a deep wrought-iron band, or ring, e^2 e^2, is shrunk round the valve, while two bridges, *f f*, retain the tubes vertically, and limit their range of action. The bars between the openings are wedge-shaped on their under surfaces, so as to offer the smallest possible resistance to the ascending column of water. The wrought-iron band, e^2, of the piston valve is turned true on its external surface, so as to move freely up and down on the cylinders, but does not require any packing.

I will now endeavour briefly to describe the mode of operation. The steam in a boiler being at a pressure of twenty-five pounds, or thereabouts upon the square inch, is admitted to the slide-valve, T, through which

Fig. 2.

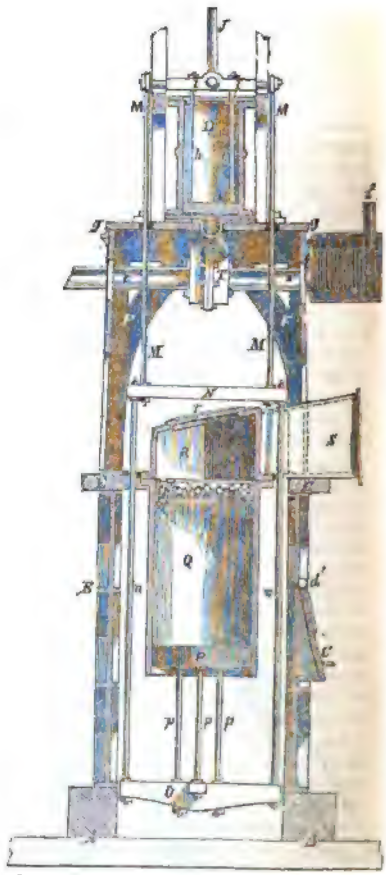


it passes into one of the steam cylinders beneath the piston that happens to be in the position for making the upward stroke. The pressure of the steam raises the piston which, by means of the piston-rods, *h h*, cross heads, I and N, and connecting-rods, M M and *n n*, already described, lifts the valved piston, P, and expels any air or water that may be above it, through the valve at the top of the cylinder, Q. The opposite steam and water pistons at the same time descend by virtue of their connection with the crank-shaft, *k*; the air, or steam, beneath the steam piston, escaping through the eduction port to the waste-steam pipe. On completing the stroke, the movement of the slide valve reverses the ports and admits the steam into the other cylinder, the piston of which is in like manner raised, and the water that is now above the second piston, P, is thrown forcibly upward through the valve at the top of the cylinder, and passes off by the exit-main, *s*, to the dividing-box, S; by this movement an ascending current of water is generated in the cylinder, and when the motion of the piston P is reversed, and it begins to descend, its valves open, and the upper current of water, generated as before described, passes through the valve until the piston P has traversed a greater or smaller portion of its downward stroke, according to the momentum acquired by the water which will be in proportion to the velocity with which the piston travels.

When the engine is employed for draining land, one or more of the sluice doors, *c*, are opened, communicating with the drains from which the water is to be taken. The side doors of the dividing-box, S, are closed, and the front are opened communicating with the channel by which the water is to be got rid of. On the contrary, if water is to be raised from a river or other external source, and thrown into the ditches for irrigation or other purposes, the sluice-door, *c*, of the well, B, communicating with the river is opened, and those communicating with the drains shut. The front sluice of the dividing-box, S, is also shut, and the side ones leading to the drains or ditches opened. By thus regulating the sluices the engine can be employed to lift water out from or into the land at pleasure. In erecting this machine, it is to be observed, that the lower orifice of the water-cylinder, Q, should not be higher than the lowest part of the drain from which the water is to be taken, as the machine ceases to raise the water when it falls below the bottom of the cylinder.

Pneumatic machines for forcing air, for blowing furnaces, or any other purpose where a blast of air is required, may be constructed in the same manner, as the hydraulic machine before described; only that in pneumatic machines the cast-iron well, B, and the dividing-box, S, are unnecessary; the former being replaced by a suitable framework of wood, masonry or metal, and the exit main carried direct from the valve-box, R, to the place where the blast is required. For pneumatic machines, I also prefer to construct the valves with tubes of gutta percha, or other elastic material, enclosing metal rods or tubes to give the necessary weight and strength thereto, in lieu of the plugged iron tubes before described.

Fig. 3.



Pneumatic machines for exhausting air, may also be constructed on the same principle, in which case the cylinders, Q, and valve-box, R, are inverted, the open end of the cylinders being placed upwards. The valve opening upward is placed at the bot-

Fig. 4.

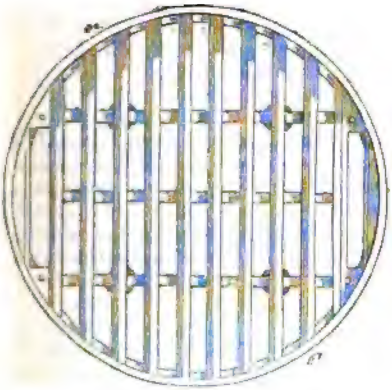
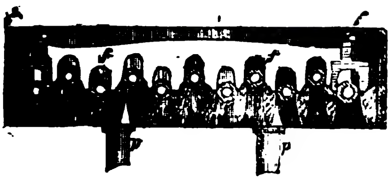


Fig. 5.



tom of the cylinder, and that which was the exit main of the forcing machine, now becomes the suction or exhaust pipe. The connecting-rods, *n n*, from the cross-head, N, pass down withinside the cylinders, Q, and are attached directly to the upper part of the piston, P. In working hydraulic machines for raising water, I have found seventy revolutions of the crank-shaft per minute to be an advantageous speed, but in pneumatic machines for forcing or exhausting air, I prefer a greater speed, say from one hundred to one hundred and fifty revolutions per minute. For working hydraulic or pneumatic machines where a steam engine is not employed, I use a winch for the application of manual power, or a vertical shaft to be turned by cattle, connecting the same by suitable gearing (as is well understood by engineers,) with a crank from which a connecting rod descends to the cross-head, N, which works the piston in the manner before described.

We intended to have added to this description a statement of some of the actual performances of this engine, and to have deduced therefrom an argument for its peculiar applicability to purposes of drainage and irrigation; but we find this part of our task so well done to our hands, in the following able letter from a correspondent, that we need but insert it as it has reached us; remarking only, that while the letter itself sufficiently attests the intelligence and experience of the writer, we have every reason to confide implicitly in his disinterestedness and impartiality.

Sir,—As a person who has been for many years engaged in the drainage and irrigation of lands in both Indies, perhaps you will allow me space in your highly esteemed Magazine, in order that I may express my opinion as to the merits of *Walker's Hydraulic Engine*, or *Patent Elevator*, to which I would wish, very particularly, to draw attention.

I consider it very essential that the present machine should not be confounded with *that* which Mr. Walker brought before the public some few years ago;* as the many modifications and improvements recently effected constitute it an entirely different affair. As it now stands, it is simply a *lifting-pump* extremely similar in outline to the ancient lifting-pump used in France (during the reign of Henry IV.,) by Lintlaer, at Pont Neuf, to supply the Louvre with water from the river Seine; and subsequently by the Dutch engineer, Rannequin, in 1682, in the celebrated water-works at Marli, near Paris; but its very simplicity, combined with the sound principles on which the valves are constructed, and the economical method of applying the power of the steam-engine, *together*, render it the most perfect hydraulic machine ever invented.

The steam-engine itself is exceedingly simple, and judiciously planned; working each time I have seen it at a pressure of 18 lbs. to the square inch. The steam boiler is about 12 feet long, with a tube in the centre; and with this small boiler the engine now erected at Mr. Walker's factory (Oliver's-yard, City-road,) may any day be seen delivering about 7000 gallons a minute 4½ feet high; to which height it is restricted by its local position. This engine is intended for the drainage of an estate of 500 acres in Norfolk; and, when it leaves the factory, will have two steam boilers (of about 15 feet by 3½ each), capable of working the engine, (at a pressure of 35 lbs. to the inch), so as to discharge 6000 gallons of water a minute, or 4,320,000 gallons a day *ten feet high!*

The cost of this hydraulic machine

* See *Mech. Mag.*, vol. xxxvi., p. 209.

entirely complete, is only about 600*l.* or 650*l.*; whilst its working expenses may be estimated at 12s. 6d. a day of twelve hours, including coal and attendance! For this sum the agriculturist may drain his land of 4,320,000 gallons of water, which is very nearly equivalent to a fall of rain of *one inch to the square foot* over 200 acres of land; or he may in dry seasons give to his land that amount of water as irrigation.

How many times do we hear the farmers of England and the sugar-planters of the Indies (especially the latter,) calling out anxiously and despondingly for a shower of rain to save their crops from partial or entire destruction! And how frequently do we hear them exclaim on the occurrence of a seasonable shower, "Ah, this fine rain is worth 1000*l.* to my property!" We have all heard this exclamation, and know full well how strictly true it is. Must we not rejoice then, when we know that such a machine as Mr. Walker's will afford our agriculturists of this country and the colonies sufficient water for the irrigation of 200 acres for 12s. 6d., when the elevation is not above 10 feet, or a trifle more when the height is greater! Those requiring a lift of 30 or 40 feet can be accommodated just as readily as those who want only 10 feet; the difference being not more than 100*l.* to 150*l.* in the first cost of the engine, and a proportionate quantity of fuel. In fact, these engines can be made to discharge 20,000, or even 50,000 gallons of water a minute, merely by enlarging the cylinders and increasing the extent of the steam power. They afford the agriculturist the means of drainage and irrigation immeasurably beyond any other description of hydraulic machine, whether pump or otherwise; whilst, at the same time, the benefit derivable from their use is not confined to agriculturists alone, but extends to all cases wherein pumps are now used.

Being greatly interested in these matters, particularly in relation to agriculture, I was invited by Mr. Walker to inspect his engine, and witness its performance, which I have done twice; and after the most careful investigation of its principles, and a strict observance of its work, I feel so entirely convinced of its great value, that I cannot but recommend it most heartily to every one whose business is in any way connected with hydraulics; and I say to all such, lose no time in seeing for yourselves this most valuable invention.

I remain, Sir, yours, &c.,

W.

July 25, 1848.

ON THE MEANS OF FASTENING TOGETHER THE COMPONENT PARTS OF VESSELS FOR NAVIGATION. BY THE LATE BRIG.-GEN. SIR SAMUEL BENTHAM, K. S. G.

[The last work on which the late Sir Samuel Bentham was engaged, was his second naval essay—its subject the *structure* of vessels for navigation; that part of it relating to fastenings, although far from what he would have considered complete, has appeared to contain so much useful matter as to have induced the present publication.

To this paper is added an enumeration of some new tools for shipwork which he had contrived, but had not brought into actual use; and of which, unfortunately, no description has been found.

As Sir Samuel was the first to introduce a consideration of the principles of mechanics in the combination of the parts of the vessel itself,* so he also was the first to apply to shipwork some of the best fastenings long ago commonly used by engineers, carpenters, and other workers in wood or metal, and further to invent other fastenings more appropriate than any already in use. His scientific acquirements, especially in mathematics and the principles of mechanics, together with his practical knowledge of ship-building obtained in the Royal Dock-yards at home, on board ship, and in action at sea, and by investigations in many foreign countries, rendered him particularly competent on the subject of naval architecture. His improvements and suggestions in this branch of science—like those of many a great man in every branch of science—have been slow of being duly appreciated and adopted; they are now, however, most of them coming into general use, with the exception of several fastenings for shipwork. It is hoped that this paper may lead to the speedy adoption of these also; and further, that by the exposition it contains of the reasons on which preference for this or that fastening rests, it may excite in naval architects attention to the principles on which the

* See *Mech. Mag.*, vol. xliii., p. 187.

efficacy of fastenings is grounded, and thus lead to the invention of others still more efficient.]

The fitness of the mode of construction of a vessel for navigation, in as far as it depends on the mode of fastening together the component parts of it, will of course vary according to the materials of which the fastening is composed, as well as of those of the pieces to be combined. The various modes of fastening in use by workers in wood and metal, other than shipbuilders, are usually well chosen according to the nature of the case; but this cannot be said in regard to the means of fastening together the component parts of a navigable vessel, and the influence which the mode of fastening necessarily has on the strength and consequent durability of the vessel, appears to be much greater than has hitherto been conceived.

Throughout the whole structure of a ship, the strains tending to disjoint the parts are either to make one part slide over another or to force two parts asunder; as also sometimes to produce both these effects simultaneously, and in different proportions one to the other. Although these effects may at any one time be produced but in a small degree, yet the frequent repetition of them is found gradually to destroy the structure altogether.

The modes in general use for fastening parts together are by means of treenails, bolts, plates, or straps of metal, nails, hoops, dovetailing, tabling, &c., and, of late years, by coques, to which may be added as having lately been partially employed, screws and cement.

Treenails and Bolts.

For parts, the close adhesion of which is the most essential to the strength of a vessel—such as the planking to the ribs and the beams to the sides—the usual fastenings are wooden treenails and metal bolts; the treenails or the bolts being driven into holes previously made in the pieces to be held in contact, and generally at right angles to the surfaces of them. The capability of these treenails or bolts to resist the strains tending to force parts asunder, evidently depends on the tenacity of the materials of which these fastenings are composed; on their being large enough, according to that tenacity, to resist the forces tending to extend them lengthways, and thereby to break them; and on their being prevented from being drawn out of the holes into which they are driven.

The strength of the fibres of wood is so great in resisting tension, that while they remain sound, treenails are seldom seen to be broken by mere tension. The strength of bolts of iron, if of good quality, and of bolts of copper, is always found sufficient to resist fracture by tension; but all of these fastenings are liable to fail in so far as regards the holding the parts to be combined close together; this failure results from the treenails or bolts being drawn more or less out of the holes into which they have been inserted.

The resistance to this source of failure must depend partly on the tightness of the parts which compress the bolt or the treenail, but principally on the extension of the surface at the ends of them; so that to be held fast, they must be driven quite through the parts to be connected, in order that the ends of these fastenings may be extended. To effect this purpose, the end of a bolt, after it is driven up, is extended by being clenched over a ring of metal put on to it; and, in the case of treenails, by their being split a little at the end, then spread open into an enlargement of the hole, so as to fill it by the insertion of a little wedge into the cleft, or by caulking it. Bolts are less adapted than treenails to be held tight in their holes, as a bolt being of a uniform size throughout its length, and the hole being bored by a tool which makes the hole of the same diameter throughout, the end of the bolt which is driven foremost extends the hole as it passes, and thereby lessens the pressure on the part near the head. These means of extending the ends of treenails and bolts, have frequently been found insufficient to prevent them from being drawn out by a much less force than that required to break them.

Independently of good economy requiring that bolts of so costly a metal as copper should be no larger than necessary for resisting the strain, it is of still greater importance, that they should be small in order to lessen that diminution of the strength of the pieces to be fastened together, which is occasioned by perfor-

ations of them, increased as it must be in proportion to the number and diameter of the holes.

Treenails.

The ordinary treenail, formed as it generally very properly is, by being split out of sound timber, and not grain cut, is seldom if ever found to be in itself deficient in strength, so as to be broken across; but not being rounded or smoothed by any suitable tool, there can be no certainty of its filling up with accuracy the round hole into which it is driven; and being, like the bolt, as large at one end as at the other, the part of the treenail which first enters the hole enlarges it on advancing, so that the part near the head, when driven up, does not fill so completely as it might the outer end of the hole. These treenails are frequently found, even at the first construction of a ship, to be incapable of drawing the plank against the ribs sufficiently close to prevent a small degree of sliding motion; nor do they prevent, on caulking between the planks, the separation in a small degree of the planking from the ribs; although afterwards the pressure of the water inwards, when the vessel is immersed in it, being great, and the plank not being exposed to any pressure outwards other than that of its elasticity, treenails are generally found sufficient to prevent the planking from separating far from the timbers, excepting at the butt-ends, and these are usually fastened by bolts.

Treenails are in general use for fastening the planks of the bottom and sides of a vessel. Being of wood, and little if anything heavier than the wood bored out of the holes to receive them, they do not add to the weight of a vessel, and they are the cheapest fastening in use for connecting the planks to the ribs and beams.

On considering, in the year 1795, the mischievous effects of large and numerous perforations of the timbers of a ship, the bad consequences arising from enlargement of auger holes by the driving of ordinary treenails, the weakness and often premature decay of timbers, planks, and treenails, consequent on a slight separation in caulking of the plank from the ribs, I was led to the contrivance and employment of treenails of a new form, that is of different diameters at different parts of their length; and of tools for boring the holes to receive them also of different diameters, suitable for the reception of the new treenail. In the way of example, supposing a plank of 4 inches thick were required to be fastened to a rib or timber—the holes were bored of 2 inches diameter through the plank, and of the same diameter, into the timber; from thence they were bored of 1½ inch diameter for 6 inches farther into the timber, but of only 1¼ inch diameter the rest of the way through it. The treenails themselves were, by means of appropriate tools, made with great exactness of different diameters at different parts of their length, corresponding with those of the holes into which they were to be inserted. The treenails were made also with a little spread at the head, the hole for its reception being suitably made by the auger. Such a treenail was easily put into its hole *by hand* to the depth of a foot, when being to be driven only the remaining depth of 6 inches, much less force was employed than in driving an ordinary treenail the whole of its length, so that the new step-shaped treenail became much more firmly embraced than is an ordinary treenail, by the wood it passed through; whilst the timbers were much less weakened than usual, in consequence of the lesser diameter of the holes. The diminution in size of the treenail as it advanced into the timber was not injurious as to strength, since the need of tenacity at the foot to resist the strain tending to draw it out, diminishes as the treenail advances, in consequence of the resistance afforded by compression on the part towards the head. The hammer in driving these treenails was not applied directly to the heads, but to a punch held upon them, which by protecting the heads from injury, admitted of the application of a greater force than usual.

Step-shaped treenails were contrived for and used in the experimental vessels of 1795, with a particular view not to weaken the timbers; and so great was the efficiency of these treenails, that, although they were fewer in number than usual, and the timbers into which they were driven less in thickness, it appeared on a close examination of the *Dart*, after a seven years' service at sea, that their hold of the posts together had been

nowise impaired: they had kept the planks in perfect contact with the timbers, notwithstanding the most severe caulking had been employed.

These treenails, first partially so introduced in 1795, were coming into general use in 1805, but seem to have been since lost sight of.*

Coques.

It was experience of the great advantage of the enlarged size of step-shaped treenails at the parts where they entered the pieces to be connected together, that being the part where the strain tending to give the sliding motion is most easily resisted, that led me to the contrivance of coques.

Coques are portions of cylinders of dry wood, about two or three inches long, and from three to six inches in diameter; they are inserted one half their length into one, the other half into the other of the parts to be connected, the whole being tied together by a small bolt or treenail passing through the parts to be connected, taking the middle of the coque in its way. The coque thus produces an enlargement of the bolt or treenail at the part where size is of the greatest importance, and this without weakening unnecessarily the parts to be connected together by large holes at any other part of the length of the bolt than that where the coque is inserted.

These coques, as well as the holes for the reception of them, are formed by engines which ensure their corresponding accuracy.

A fastening of the same kind might be made of other forms,—square, for example; but the workmanship of any other form than circular, to ensure accuracy, on which its efficiency depends, would be more difficult, and consequently expensive. It is true, coques might be cut to a square form with great facility and perfect accuracy, as by a circular saw, but not so the holes into which they are to be inserted; whereas not only the cylindrical coque may be cut by a tool turned round it, or in a common turning lathe; but the hole also to receive it may be made with perfect accuracy by a boring tool.

The coques being made of dry wood, and kept perfectly dry till the time of their insertion, any small degree of swelling afterwards from moisture, tends to hold them so much the more tightly in their places.

These coques were first employed for connecting together the component parts of masts; whereby, besides saving the considerable expense of an extra thickness of the pieces, to admit of forming the tabling according to the former mode of connection, there was immediately a saving of 25 per cent. on the workmanship; and they are now in very extensive use in shipwork.

The rapid introduction which took place of this invention, affords an example, that fortuitous circumstances have often as much influence in the introduction of improvements as their intrinsic merit. It happened soon after I had contrived this new fastening, that a visitation of the Lords Commissioners of the Admiralty to the dockyard took place; at Portsmouth, coques, and the mode of using them, were pointed out as novelties, and attracted much attention from their usefulness and economy, so that their lordships' own conviction from inspection induced them, without any reference to inferior boards, to give positive orders for a general introduction of coques. On the contrary, others amongst the fastenings I have contrived and endeavoured to introduce, not happening to have been exhibited to, or to have otherwise particularly excited the attention of the superior authorities, have scarcely, I believe, to this time, been employed, although engines have been furnished to the dockyards for making those new fastenings. I may instance, step-shaped treenails, bolts with screw points to receive nuts upon them, large hollow screws—all of them fastenings no less well suited to their respective uses than the coque.

Bolts.

As to bolts of metal, their use and effect are the same as those of wooden treenails; but the superior strength of metal over wood, enables a metal pin of small diameter to afford the same degree of strength as a wooden pin of large diameter, so that with a view to diminishing the size of wounds in the parts to be connected, metal bolts are in many cases used in preference to treenails. The accuracy of surface of a common

* And still are so in her Majesty's dockyards, at least in 1848.

bolt gives it an advantage in this respect over common treenails; but it has the disadvantage, compared to a treenail, of not extending in the least in diameter after it is inserted, whereas a treenail is inserted very dry, swells in some degree with the moisture, to which it is afterwards exposed, even with that of the atmosphere, and thus fits more tightly into its hole.

There are the same reasons for making bolts *step-shaped* as those that have been given in regard to treenails.

Bolts in common use after insertion are riveted or clenched at the ends, on the same view and with the same effect that treenails are split at the ends, and enlarged by wedges.

If the surfaces to be connected together by bolts, be placed in perfectly close contact, fastenings such as these may in the first instance prevent the separation of those surfaces; but such fastenings of themselves are ill suited by means of riveting to draw the parts together with sufficient force to press into each other the little irregularities in the surface of pieces to be connected, and which, if so pressed, might prevent sliding motion: therefore, should the substance of the parts so combined contract afterwards by dryness or otherwise, though it were only the hundredth part of an inch, any sliding motion, when eased of this friction, is no otherwise resisted than by the stiffness of the bolt. Besides this, the bolt, by the effect of reiterated strains on the structure, although it may not bend, is apt to gall into the wood, so as to enlarge the holes, and thus admits of that working which is so destructive of the general structure of a vessel.

The efficiency of a given quantity of metal in the form of bolts as now used, might often be increased by forming it into a double number of small bolts, especially if step-shaped; and still more so if, instead of being driven in the middle of the piece to be held, they were to be arranged in two rows, each as far as possible from the middle of the piece.

The great expense of copper bolts is, of itself, a sufficient reason for substituting, wherever practicable, the cheaper material, wood; but besides expense, it would be advisable on another account, namely, that the quantity of metal used for fastenings may, in case of disasters at sea, cause the vessel when full of water to sink, whereas, had wood only been used as fastenings, she might still have buoyancy sufficient to keep her afloat.*

(*To be continued in our next.*)

THE SEA WALL QUESTION—MOTION OF THE SEA.

Sir,—Now that your valuable Journal has fairly brought before the public the subject of sea walls, I will beg of you to allow me to make some very brief remarks on the subject.

Let us suppose we are some miles from the land, in deep water, and (to save time) let us also suppose there is a strong wind blowing in the direction of the nearest land, and a high sea on.

Now, in this case, whatever may be floating on the surface will merely rise and fall with the sea, and travel over it only as the part above the line of floatation is influenced by the wind, for the sea in deep water does not travel,† but the formation of the wave does, and in the direction of the wind. (We are to suppose it is not influenced by tide or currents.) Let us, in imagination, follow the wave. As we near the land, we shall in all cases where a sea wall is required, get into less water; we shall now find that the sea will gradually assume a different character, for in deep water it but rose and fell, the agitation of the surface expending itself before reaching to the bottom. But as we approach land, the depth from the surface to the bottom is gradually becoming contracted, not leaving sufficient space for the formation of the wave to travel, without coming in contact with the ground. As soon as this is the case, the upper portions of the wave will travel quicker than the lower, in consequence of the friction produced in passing over the bottom. The sea has now commenced to travel, and from the same cause it increases in velocity as it nears the land. The friction of the bottom also imparts a rotary motion

* So little, generally speaking, is the cost of copper fastenings considered, that in a proposal from a shipbuilder, referred to Sir Samuel, to substitute bolts for treenails in fastening the planks of ships, professedly for the purpose of economy, by saving thickness of the timbers, Sir Samuel found that, instead of the £360, or thereabouts, which the treenails for that purpose cost, the expense of the copper bolts and rings proposed would amount to about £15,000!

† The crest of a sea when broken by the wind will cause that and other particles it may come in contact with to alter their situation, but *not to travel*.

to each wave, and to each particle composing that wave; every yard of distance, and every inch of decrease in depth, augmenting this motion, which increases the speed with which the sea travels over the bottom, until it attains to that enormous velocity we may so often witness on the beach of an open sea. I have frequently seen, when the bottom has been peculiarly formed, the seas actually jumping from the ground as they approach the strand; the friction being so great that the high velocity could not be kept up by any other means. We, therefore, know that the power of the sea to overthrow a wall or any other structure is greater the nearer we approach the natural boundary, and consequently less and less, the farther we recede from it and get into deep water. We may also see the reason why it does not break upon a perpendicular wall which is in deep water.

The objections to perpendicular walls are many; but the most formidable is the enormous expense. In our advanced state we may be said to have outstepped progress, and our requirements in the shape of harbours of refuge and many other national undertakings have become numerous; therefore, it is absolutely necessary that what is done should be on the most economical scale, and productive of the greatest effect. Perpendicular walls have not, do not, nor will they ever fulfil either of these conditions. When the sea does break upon the wall, which it will do if in shallow water, the liability to get out of repair is very great, and when damage is done it is next to impossible to reinstate things as they were except by a new wall.

Space will not allow me to enumerate any other objections, which as I have above said are many. But if I may encroach a little farther on your valuable pages I will venture my opinion as to the form which should be given to a sea wall or breakwater.

Take chalk or stone, (which is to be got at, or near, all localities) as it is broken out of the cliffs or otherwise, from the size of a walnut to one, or, one and a half foot cube, and shoot it over the line of wall or breakwater, leaving it to be formed by the sea, which has all the capabilities of effecting this in an infinitely superior manner to any which our skill can command. Where chalk is used, the surface, which is not at all times immersed, may be covered, in like manner with stones, to protect it from the action of the atmosphere. When formed, the mass may be consolidated by a very simple and cheap process; and when once properly completed, generations and ages might pass away without effecting a change. Chalk, when immersed, becomes very hard and durable.

In conclusion, I will most respectfully remark, that Mr. William Dredge's observations respecting the angle of percussion and recoil would not be applicable in any other case than a wall in deep water. For, if in (we will say) 10 feet, a sea were to strike an inclined plane at the point "*d*," it would not recoil to "*f*," but rush up the plane towards "*b*," in consequence of the impetus the sea has acquired in passing over the ground before striking. Hence we see the decided advantage this form of face has over the perpendicular, for the latter would have to overcome the whole of the impetus at one shock.

I remain, Sir, yours respectfully,

WM. BELL.

July 26, 1848.

SEA WALLS—SHOULD THEY BE SLOPING OR VERTICAL?

Sir,—The advocates of the long sea slope universally lay it down as a basis for their reasonings, that the efficiency of the upright face can be maintained only upon the assumption, that the waves of the sea during storms have no progressive motion or percussive force, and therefore do not break upon the upright face. Whether this amounts to a true enunciation of the belief of those who advocate the upright profile, I cannot say; but true it is, beyond all doubt, that any belief founded upon that assumption would be erroneous. The onward motion of the waves of the sea, and their momentum, are demonstrated in many ways, but in none more satisfactorily than by the valuable experiments of Mr. Stevenson with his marine dynamometer.

It is conceded, then, by the advocates of the long slope (and who will deny it?) that the force developed by the blow of the sea is exerted at the moment of impact in a horizontal direction; and this important point having been previously

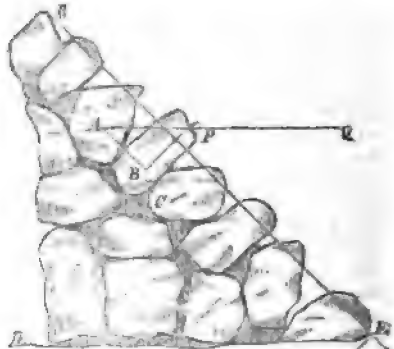
settled, we shall proceed hereafter to apply its consequences to the sloping sea face. And now, in the first place, permit me respectfully to ask your correspondents who have taken a part in this discussion, why it has happened throughout, that not one single attempt has been made to apply the ordinary principles of mechanical science to guide us to a safe conclusion? A subject purely mechanical has been discussed at considerable length, the data being forces applied in given directions upon rigid substances: twenty conflicting opinions have been formed and put forward; and it is gravely said that this is a case in which mechanical science can lend no aid, because, forsooth, it is the case of a great breakwater.

The "strong opinions of eminent engineers" have been referred to on both sides; the "practical experience" of others. I am far from undervaluing either the one or the other; but I would beg to impress upon the minds of all who may not have attained such eminence, that the *unexplained opinions* of men, however exalted their position, should never be adopted, as they too often are, as substitutes to supply the place of their own searching inquiries. As it is, the "strong opinions" and "practical experience" of those eminent men have left this important subject in such a state, that unanimity of opinion respecting it is now almost too much to be hoped for.

It would be an unwarrantable intrusion upon your valuable space to repeat, in any shape, the mere opinions which have been put forward by your correspondents; and it is purely with the hope of being able to turn the subject into the channel of independent investigation, irrespective of the opinions to which eminent men are already committed, that I venture to trouble you with this paper.

Let fig. 1 represent the section of a portion of a sloped sea face standing at any inclination, DER, to the horizon. Now, by the common consent of all the advocates of the slope, the blow of the sea strikes it in the horizontal direction, QP. The mechanical reaction of the sloping plane itself, actually resolves the force developed into the two equivalents, BP and BA, respectively perpendicular and parallel to the plane, the latter being expended in urging the water up the plane towards R, while the former, being

Fig. 1.



the direct shock, is entirely sustained and destroyed by the plane. Now, it may be easily shown that the portion BA of the whole force which acts up the surface of the plane *increases* as the sine of the angle, DER, *decreases*, and that the actual shock, PB, upon the plane *decreases* in the same ratio. Hence, then, is truly verified, the saying of Professor Barlow (vol. xlviii., p. 574), that "much of the *direct* violence of the water is avoided by receiving that action upon an inclined surface."

But it is necessary that we should carefully trace the *indirect* action of the component, BA, not only up the plane towards R, but also in its descending course down the plane towards E. And here, let me observe, in my humble judgment, lies the radical defect of any rough sea surface—the root of that evil, which has consumed unavailingly, enormous amounts of labour and expense, and which must ever remain the source of destruction in any *rough* sea slope, so long as the laws of nature remain immutable.

It has been shown that a component, BA, of the whole force which strikes the plane, acts along its surface in the direction ER; and whatever the whole force may be in any given case, in flat slopes the component, BA, comprises by far the greater part of it. This force, in passing along ER, will strike the stone, B, near the point, P, and the effect will be that the stone B will be turned upon its own axis, and a moment of force be developed, having PB for a lever, which, acting upon the

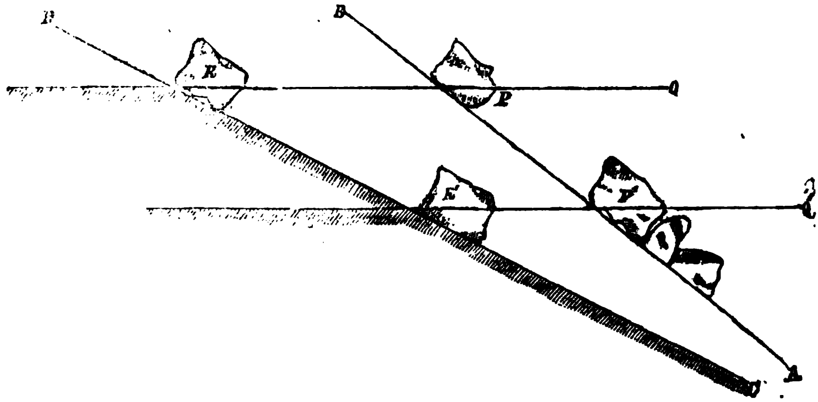
stone, C, will kick it out of its bed as effectually as a man would with a crowbar. Again, the body of water, in descending from R to E, impinges upon the same stone B, near the same point P; and a similar force is developed, which tends to throw out the stone, A: and so this operation is continued until the face of the slope is breached, and then the work of destruction proceeds rapidly, and is easily consummated.

Your readers, no doubt, have observed that, throughout the whole of the arguments for the long slope, one prominent idea prevails, namely, that some portion of the violence of the waves is *altogether avoided* through the intervention of the slope. Indeed, in some parts of Sir Howard Douglas's Protest, this idea assumes such a definite shape, that it might be fairly enunciated as follows:—"Because the whole *direct* force of a wave upon a slope is less than upon an upright surface in a given ratio; it therefore follows, that so much of the action of the water is *entirely avoided* as corresponds to that ratio." Now, it will require but little thought to discover that this is a serious mistake. It is true, that PB (fig. 1) is the only portion of the force directly sustained by the slope, which is usually *small* as compared with that turned up the plane; but it must be remembered that the breakwater is not an abstract plane, but a physical body composed of an aggregate of particles, each of which is liable to be acted upon, and even the whole carried away in detail; and it is, consequently, not enough merely to say, that the force of the waves is exhausted in running up the rough incline, without duly appreciating their effects upon the work in doing so, and the ruinous consequences that must be the result, as before illustrated.

Sir Howard Douglas in his Protest enforces at great length, and with singular ability, the opinion that the long slope should not be uniform, but that it should be flatter and flatter as it ascends towards high water, and generally, where the force of the waves is strongest, the slope there should have the least inclination to the horizon. Sir John Rennie, too, (vol. xlviii. pp. 424, 425) labours hard to establish the prescience of his illustrious parent in the case of the slope of 5 to 1. The doctrine laid down by Sir John Rennie, and his investigation of the effects upon a slope of 3 to 1, as compared with that of 5 to 1, involves in a great measure the whole controversy as to whether sea faces should be sloping or vertical. If it could be demonstrated that it was possible by any natural means for a slope of 3 to 1 built of certain materials, and rising to a certain horizontal level to be destroyed by the sea, and in its stead established by the same agency, a slope of 5 to 1 of the same class of materials and to the same horizontal level; then I should say the important problem was at length solved, and any intelligent man would see at a glance the disadvantages of every slope between that limit of 5 to 1 and a vertical face, which, in the event supposed, would stand as the extreme limit of ill-conditioned forms. Now, Sir John Rennie lays down this doctrine for a particular case, while Sir Howard Douglas asserts the generalization of the proposition; and I candidly confess, I feel it a hard matter to question any assertion so positively made by such high authority. But there appears to me beyond doubt something in this doctrine which requires explanation, and even suggests the possibility of its utter fallacy; for it clearly amounts to saying, *That a given weight* (say a stone of three tons) *having a given force applied to it in a horizontal direction, is more easily pushed up an inclined plane of* 18° *than up one of* 11°, *the inclinations being taken with reference to the horizon.*

Referring to the diagram (fig. 2), AB and CD are slopes inclined to the horizon at 18° and 11° respectively. By Sir John Rennie's account of the Plymouth Breakwater (vol. xlviii., p. 424) the material included between those two lines was carried over the top of the Breakwater and deposited at the rear slope, reducing the slope AB of 18° to CD of 11°; and hence it is laid down as a fundamental truth, that the sea itself had thus found out a lower plane CD, up which it *could not* remove the stone R^1, notwithstanding that it had by an equal force carried away similar materials from P^1 up a higher plane AB, and over the apex of the Breakwater. Sir Howard Douglas's general assertion amounts to this: that whereas a horizontal force which is *not* enough to give motion to the stone, R^1, up the plane CD of 11°, will not only push it up AB of

Fig. 2.



18°, but that it is in perfect accordance with the deductions of science that it should do so.

But as the waves of the sea increase in height, the intensity of their force is also increased. I admit this; but the force in the horizontal line QR, whatever it may be, is the same whether it strike an obstacle at P or at R; and the question returns—Can the stone, P, be carried up the plane P B, while the stone R, under precisely the same circumstances, remains quiescent upon the lower plane RD? All the arguments which have been advanced in favour of the long slope reply to this question in the affirmative; and I therefore beg to submit that the authors of those arguments are fairly called upon to explain.

It appears from Sir John Rennie's account of the Plymouth Breakwater, that whenever the slope was reduced by storms from 18° to 11° that the top of the work was also lowered in a corresponding ratio. The sea therefore not *only* reduced the slope to suit its own violence, but it also lowered the top of the work to allow a freer passage over it. Had the work been carried up on the slope, CD, the stone, R, would have been still more easily carried away than the stone, P, at the same level, and the effect would have been to flatten the higher part of the slope, CD, and thus bring it down to suit the lesser force of the water at that particular level, and a still flatter slope would have been established upon the higher parts of the 5 to 1 profile.

It appears impossible, therefore, to draw a clear inference that any *angle of repose* could possibly have been established; and considering the direction of the forces applied, if an angle of repose could not be found upon an inclined plane of 18°, it is not easily conceived how it could have been found upon the lesser incline of 11°. The fact *per se* of the slope having been reduced from 18° to 11°, with a corresponding *depression of the top of the work*, does not establish a relation between the force of the sea and the slope *exclusively;* but simply shows that the whole mass was reduced to that lower level where the resistance of the materials became equal to the abrading force. Had no depression of the work taken place on top, but the incline of 5 to 1 been carried out the full height, it would still have remained to account for the phenomenon upon philosophical principles; but as it is, I believe that all that has been stated may have happened without establishing any necessary relation between the force of the sea and the inclination of the slope.

Respectfully yours,
T. Smith.

Bridgetown, Wexford, July 31, 1848.

BIRD'S PATENT IMPROVEMENTS IN LIQUID MEASURES.

[Patent dated February 8, 1848. Specification enrolled August 8, 1848.]

1. The improvements which form the subject of this patent have relation, firstly, to the measures made of pewter, tin, and other metals, ordinarily used by retail dealers in selling spirits, beer, oil, and other liquids, and have for their object to facilitate the transfer of the liquid from the measure to the bottle or other receiving vessel, and also to prevent the waste attending the common practice of turning the measure over for the purpose of emptying it. Instead of making the measure of a cylindrical or barrel form, with flat bottom, as usual, the patentee makes it of a globular or conoidal form, with an open orifice at bottom, to which orifice he attaches a tap or cock, by which it may be closed during the filling of the measure, and opened when it is desired to empty it. The tap is to be attached to the measure by soldering, or by any other suitable means. It is preferred to make it of the sort of alloy of which liquor taps are commonly made, called sometimes pot metal, and at others cock metal; but the patentee does not confine himself to any particular material for the purpose. On the exterior of the tap, four vertical fillets are cast, in order that, when inserted in the mouth of a bottle, it may not fill the same exactly, but leave air spaces between it and the glass, for the escape of the internal air, as the liquid is being poured in.

2. A second branch of the patent relates to the serving by measure of milk, beer, and other liquids out of portable pails, cans, and other vessels, and has for its object to supersede the necessity of carrying along with such pails, cans, and other vessels, the various measures requisite for distributing the contents of the same, according to the wants of customers, as quarts, pints, gills, &c. The patentee constructs the pail, can, or other portable vessel, with such appendages that it shall itself measure exactly whatever quantity of the contained liquid is drawn from it. The vessel is provided, as usual, with a lid or cover, which may, if desirable, be made fast with a padlock. A small circular box, containing the principal portions of the measuring apparatus, is mounted on the top of the lid or cover. On the upper and outside surface of this box there is a circle, graduated, after the manner of a clock-dial, into gallons and the aliquot parts of a gallon. At the bottom of the vessel there is a tap (similar to that before described) for drawing off the liquid. A ball-cock floats on the surface of the liquid, and is connected by a lever with the horizontal axis of a bevel-wheel, which gears into another bevel-wheel which is fixed upon a vertical spindle, which passes up through the top of the box, and exactly in the centre of it. To the upper end of this spindle is attached an index-hand, which points to the words and figures on the graduated surface of the box. The mode of action of this machinery is as follows:—When the vessel is filled with milk or other liquid, the ball floats upon the surface, and occupies a hollow space made for it on the under side of the lid or cover of the vessel. As the liquid is drawn off, the ball, by its own gravity, descends, and pulls round along with it the first bevel-wheel, which causes the other bevel-wheel, into which it gears, and the index-hand attached to the axis of that wheel, to be turned round a proportionate distance, so that by noting the space on the graduated surface traversed by the index-hand during the first draught from the vessel, or between any two draughts, the exact quantity delivered each time can be at once ascertained. As, however, the ball-cock describes a portion of a circle in its descent, it is obvious that, for the same quantities of liquid taken from the vessel, when full and when nearly empty, it will not cause the index-hand to travel over equal spaces, and therefore, in order to correct such inequalities the patentee graduates the surface of the box according to actual experiment and observation of the spaces successively traversed by the index-hand, during one entire emptying of the vessel.

Another arrangement of apparatus suitable for measuring the liquid contents of large stationary vessels, such as brewers' and distillers' vats, or, in other words, for rendering the same self-registering, is thus described. The ball-cock is attached by a chain passing over a friction-pulley, placed on the top of the vessel, to a set of wheel-work placed in a case affixed to the vat on the outside. As the fluid is taken from the vat, the ball-cock descends, and by the action of the chain upon the wheel-work, causes the index-hand to point out upon a dial-plate in front of the wheel-work the exact quantity of fluid which has been taken from the vat. The rewinding of the chain on the barrel of the wheel-work, upon refilling the vat, is effected either by winding up the wheel-work, or by the action of a spring placed in connection with the barrel upon which the chain is wound.

A third contrivance, for the same purpose, consists of a glass tube, which is affixed to a graduated scale placed on the front of the vat. The tube is bent at its lower end, and

the bent part is inserted into, and has free communication with the vat. The liquid, consequently, will always stand at the same level in the glass tube and the vat, and any quantity which may be drawn off will be indicated by the fall of the surface of the liquid in the tube, while, at the same time, the quantity left in the vat will be indicated on the scale. Instead of the tube being made entirely of glass, it may be made of metal, with a glass front inserted into it, which would greatly diminish the risks of fracture; and the communication with the vat at bottom may be effected by means of a metallic pipe and stop-cock.

SANITARY REFORM v. THE INSANITY OF SCIENCE.

"If an apology be necessary for the following remarks, my excuse will be found in the novelty of sanitary legislation, the apprehension that errors in details, or complication in the machinery, may impair the working of the measure, the literally vital concern which the people have in its enactment, and the unusual perils to which the public health is exposed, from extraordinary states and changes of the atmosphere, and the continued menaces of renewed invasion by the cholera."

PUBLICOLA.

Sir,—It has ever happened that, on the introduction of any novel and extensive measures, embodying important improvements in domestic science, a tolerable degree of practical efficiency has only been attained through a long series of blunderings; and this, even in cases involving merely a common sense application of well known and long established scientific principles. The course taking by the "almost all-absorbing topic of the day"—sanitary reform, gives no indication of becoming any exception to the general rule. We of the nineteenth century have just stumbled over the fact (doubtless well known even to the antediluvian world), that a sufficient quantity of "pure air" is, among other things, essential not only to the happiness and well-being, but to the very existence of the human race. I say WE have just come to the knowledge of this fact; for, although in individual cases such matters have long been well understood and insisted upon; yet, as a *people*, we have only just become conscious of "the lamentably imperfect sanitary arrangements existing in this country, and of the better systems (in many respects, at least) instituted in some parts of the continent." The ordinary essentials of health having been established—and the lamentable disregard of them by the community made apparent—by a "Sanitary Commission," remedial measures have in consequence been propounded, and the "Health of Towns" has now become the object of legislative care. What incongruous subjects will—or, rather, what will not—eventually be included in "Health of Towns Bills?" it were very difficult to say. The condition of the mind, body, and breeches-pocket—cleanliness and morality—pleasure and profit—protection from fire and flood, as well as most of the other ills that flesh *was* heir to—will, doubtless, hereafter be incorporated in the ramifications of this comprehensive measure.

While theorists are settling general principles, however, practical men show a disposition to grapple with details, applying the results of "careful study" to the public good. The cesspools, presenting an extensive field for useful employment, have been first attacked. One party most judiciously proposes to *deodorise*, before disturbing, the contents of these soon-to-be-exploded receptacles, and afterwards to remove the deodorized matter without producing any annoyance. Another party has been operating pretty extensively upon the cesspools in Clerkenwell, St. Giles's, and other low neighbourhoods, on a different plan; viz., by pumping the exuviæ into the sewers, diluting and agitating the matter, so as to produce a copious evolution of such "vile smells" as have only been tolerated at Harrowgate, under the presiding deities of Health—or Fashion! The plan adopted has been, to run a copious stream of water into the cesspool, and then pump the night-soil, in its diluted and diffused condition, into the nearest drain; thus causing a most intolerable stench to rise, through every untrapped opening, between the spot operated upon and the outlet of the sewer. Our unenlightened forefathers had the good sense to restrict the intermeddling with such deposits until after "midnight's witching hour;" our modern "*nightmen*," however, with a laudable disinclination to hide their candle under a bushel, and with an utter contempt for all such paltry and arbitrary distinctions as day and night, invariably take broad daylight for their performances. Although this mode of getting rid of the contents of cesspools is effected with little trouble or annoyance to the

operators, it produces an abominable nuisance in the neighbourhood, and is, altogether, a most wasteful mode of proceeding, both as regards the water that is expended and the matter thrown away. The latter objections might be obviated by the employment of Messrs. Dean, Dray, and Dean's cesspool cleanser (fully described at page 151 of your 48th vol.); but this is not *perfection!* In the old-fashioned way of emptying such places, with the cart and pail, a certain quantity of noisome odour escaped into and tainted the atmosphere; but every tyro in science knows how greatly it would be possible to increase the quantity of offensive exhalations, by *agitation*, and *diffusion of surface* in *vacuo*. Now, this is exactly what Messrs. Dean, Dray, and Dean's apparatus most effectually does; they provide an air-tight cart or waggon, "*from which no effluvia can escape,*" on the top of which is fixed an *air-pump;* from the body of the cart a feed-pipe passes down into the cesspool to be emptied. On working the air-pump a partial vacuum is formed within the body of the cart, when the pressure of the atmosphere forces the semi-fluid night-soil up the feed-pipe into the waggon. Being most effectually disintegrated and agitated in its passage, the matter freely parts with its offensive vapours to the exhausting influences of the air-pump, the noxious effluvia continuing to be extracted, and pumped into the atmosphere most energetically until the waggon is "full." The night-soil thus acted upon will be pretty considerably *deodorised*, without the aid of Mr. Ellerman. If previously *deodorised* by that gentleman's process, the air-tight vehicle is hardly necessary; but, under any circumstances, the employment of an *air-pump* for such a purpose, either as regards the cost and delicacy of such an instrument, or its action upon the matters to be removed, is about as bad an arrangement as could possibly be resorted to. It is just the *reverse* of what sane science would suggest.

Unless it be that the *fertilizing power* of night-soil is enhanced by this exhausting operation, I am at a loss to perceive on what grounds the Royal Agricultural Society, at their York meeting, awarded a prize to Messrs. Dean, Dray, and Dean's cesspool cleanser, certainly a *non-agricultural* implement! I can only solve the difficulty by supposing it was done for the sake of consistency, and to maintain the perversity of their decisions, agreeably to which, at the Northampton meeting, they gave prizes to the steam-engine that burnt the most coals, and the fire-engine that took most men to do the same quantity of work!

The introduction and perfecting of sanitary reform is, after all, only a means for the alleviation of miseries of our own creation. Still, they were created unconsciously; in disregard, it may be, but not in hostility, to human health and happiness; and their removal or alleviation is the work of science and legislation, conscientiously, diligently, and philanthropically directed towards their noblest ends. Quackery avaunt!

I am, Sir, yours, &c.,

W. Baddeley.

29, Alfred-street, Islington, August 5, 1848.

[With all respect to our esteemed correspondent, Mr. Baddeley, we must say that we do not see wherein the force (if any) of his objection to Messrs. Dean, Dray, and Dean's cesspool cleanser lies. Surely, it must be allowed to be a great improvement, in a mechanical point of view, to raise, by the pressure of the atmosphere acting against a vacuum, matters which would otherwise have to be raised by scoop and bucket. What have deodorization, or delicacy, or anything of the sort, to do with this? In either case, there must be agitation of the matters raised, and no more in the one case than in the other.—Ed. M. M.]

REMINGTON'S SYSTEM OF BRIDGE BUILDING.

Sir,—In the last Number of your Magazine, you published a description of a bridge lately erected across the Trent, near Ingestre, by Mr. Remington. A model bridge, on the same principle, has been standing for some months in the Surrey Zoological Gardens; and it was also, at the time of its erection, briefly described in your pages.

In the construction of these bridges, it is evident that the object the architect has in view, is to make the longitudinal supports or stringers (as he terms them) sustain the bridge by the direct cohesion of the fibres; and this he partly effects, but not to the extent his description would lead us to suppose.

If the stringers were as flexible as a rope or chain, and firmly attached at their extremities to fixed abutments, they would then, doubtless, assume a catenary curve; the strain would be in the direction of the fibre, and the statical conditions of the structure elucidated by the formula applicable to the catenary.

As there must, however, be always a certain amount of stiffness in the stringers, this will tend to prevent them from being adjusted to the action of the transit load or any moving weight, and consequently throw a cross strain in them. In consequence of the stiffness, the stringers will approximate in action to that of the girder, the equation of which is

$$W = \frac{4shd^2}{2}$$

Where W is the load which the girder will support, s a constant quantity determined by experiment, and hd and l the breadth, depth, and length, all in inches.

If the bridge is on the principle of the catenary, then

$$W = \frac{2\,Ea}{\text{cosec} \angle \text{ of suspension.}}$$
$$= 2\,Ea \sin \angle \text{ of suspension.}$$

Where E is the cohesive strength per square inch, and a the area of a transverse section of the stringer at the abutment.

Reducing these equations to numeral examples which will coincide with the bridge at Ingestre, we have,

First, $l = 150 \times 12 = 1800$, $h = 5$ and $d = 5$ inches, and $s = 1600$ lbs.

$$W = \frac{4 \times 5 \times 5^2 \times 1600}{1800} = 444{\cdot}4 \text{ lbs.}$$

for the absolute transverse strength of each stringer, which, for the six, gives, as the load which would break the bridge if it acted as a girder,

$$= 444{\cdot}4 \times 6 = 2666{\cdot}4 \text{ lbs.}$$

Secondly, on the principle of the catenary,

$E = 11000$, $a = 25$, and sin of $\angle$ of surface $= \sin 3' \, 40^\circ = {\cdot}063952$; whence

$$W = 2 \times 11{\cdot}000 \times {\cdot}063952 \times 25$$
$$= 35170 \text{ lbs};$$

or, the six stringers will support

$$35170 \times 6 = 211{,}020 \text{ lbs.}$$

It must not, however, be supposed that the bridge is as strong as this.

Mr. Remington's bridge is, properly speaking, neither a girder bridge nor is it entirely supported by the direct cohesion of the stringers, but approximating to one equation or the other, in proportion to the stiffness or flexibility of the supporting timbers.

I cannot see much novelty in the design, for bridges of this description, with iron chains instead of the timber stringers, have been in frequent use for military and occupation bridges, and they are also to be met with, supported by ropes of grass, amongst the mountain passes of the Himalaya, and in America amongst the Andes. The action of the bars across the Avon, at Clifton, is also upon the same principle.

The greatest objections to bridges on this plan, especially when built of timber, is, that it is impossible to calculate their strength, or to know whether each individual bridge approximates nearest to the girder or the catenary construction. If it approximates the former, the absolute strength is very small—if, on the other hand, the flexibility of the supports admits its approach to the catenary, then the motion is exceedingly unpleasant and objectionable.

If I am wrong in the above rather hasty remarks, Mr. Remington will have an opportunity, and I trust will have the kindness, to set me right.

I am, Sir, yours, &c., M.

London, August 8, 1848.

GREAT FIRE AT NEW YORK—SUPPOSED CAUSE, THE EXPLOSION OF INCANDESCENT NITRE BY THE ACTION OF WATER.

In July, 1845, a prodigious explosion, or rather series of explosions, took place in a store in Broad-street, New York, by which the contents of the building were thrown in an intensely ignited state over the surrounding neighbourhood, and about 200 houses and two million dollars' worth of property were destroyed. At a late meeting of the Franklin Institute the probable causes of this disaster formed the subject of a very interesting address by Dr. Hare, of which the Journal of the Institute gives the following abstract:

As far as the oaths of highly competent witnesses could avail, no gunpowder was present; so that the result could only be attributed to the reaction between an enormous quantity of nitre and combustible merchandise with which the store was pro-

miscuously occupied. In all there were 300,000 lbs. of nitre in parcels of 180 lbs. (each secured by two bags, an additional bag having been put over that originally employed.) About 180,000 lbs. was situated upon the second floor, 50,000 lbs. on the first floor, and 80,000 lbs. on the third floor.

Of the merchandise, the aggregate was more than double the weight of the nitre.

It was, however, the general opinion of those best acquainted with the subject, that when ignited with combustibles, nitre produces only that species of combustion which is called deflagration by chemists, without being capable of the more violent and instantaneous reaction designated by the word explosion. This impression was strengthened by the failure of every effort (made by several eminent chemists employed by the corporation of New York) to explode nitre by ignition with combustibles.

Nevertheless, agreeably to Hays, of Massachusetts, an explosion was effected in his laboratory, by bringing water into contact with about 100 lbs. of incandescent nitre; also the accidental falling of a jet of melted nitre on some water, in the laboratory of the University of Pennsylvania, had been productive of a similar result.

The explosion of a vessel laden with nitre, which, while lying in Boston Harbour, was burnt to the water's edge, and of others similarly laden and burnt, could only be explained by supposing that nitre, when sufficiently heated, will explode with water in due contact. Consistently, it might be inferred that this salt (well known to be a compound of nitric acid and oxide of potassium or potash) would explode with any substance capable of yielding either or both of the elements of water or hydrogen. The presence of the latter would be equivalent to water, since it would, with the oxygen of the acid, form water.

In a letter, addressed to the distinguished chemist above mentioned in July, 1845, Dr. Hare has adverted to the explosion which succeeds the combustion of potassium upon water, as arising from the combination of one portion of the water with the resulting incandescent globule of oxide, while the heat of this globule uniting with another portion of the liquid, converts it into high steam. Moreover, it was suggested that in this instance, chemical affinity between the water and the oxide, in causing the water and heated globule to coalesce, is equivalent in efficacy to the momentum of the hammer when a bar of iron, at a welding heat, is forced into contact with some moisture situated upon an anvil.

Dr. Hare presumes that no explosion can take place unless the reagents for producing it are held or brought together, at the moment of reaction, by a certain force, either chemical or mechanical.

Some chemical compounds, such as are formed with fulminic acid, or with ammonia, by metallic oxides, also the chloride of nitrogen and perchloric ether, explode violently without confinement, so as to fracture a plate or saucer, upon which a small quantity may be detonated; but pulverulent mixtures, such as gunpowder, however powerfully explosive when employed in gunnery or rock-blasting, in open vessels flash without fracturing them, or producing any report. In an exhausted receiver, gunpowder is far less explosive than when subjected to atmospheric pressure in an open vessel. Nevertheless, when gunpowder is restrained until the temperature requisite for the appropriate reaction of its ingredients is attained, it exerts a force far exceeding that of the chamber confining it. In this respect it differs from steam, of which, when the temperature of the fire applied is sufficiently high, the explosive force is directly as the pressure before bursting, and this, of course, is commensurate with the strength of the confining boiler.

The ingredients of gunpowder, sulphur, charcoal, and nitre, to produce the greatest effect, require extreme comminution and intimate intermixture by trituration, and to be so granulated, that the flame of the portion first ignited may convey inflammation to the rest through the interstices between the grains. Its superiority over any other mixture of nitre with combustible matter destitute of sulphur, is conceived to be due not only to the pre-eminent susceptibility of this substance, of vaporization and inflammation, but likewise to its well-known ability to decompose metallic oxides by attracting both the metal and oxygen. Since an opinion was expressed in 1845, in the letter above mentioned to Hays, that the formation of sulphide of potassium is the first step in the process of the explosive reaction of gunpowder, Faraday has alleged the flame of this compound to be, in the case in point, an important instrument in the propagation of fire throughout the mass.

The hepatic odour of the fumes consequent to the firing of cannon, and likewise of the washings of a gun after the customary service, demonstrate the production of a sulphide. It has been found that a filtered solution of the residue displays, when tested by iron, the red hue which indicates the presence of a sulphocyanide.

Agreeably, however, to a qualitative examination, the solid residue of exploded gun-

powder consists mainly of nearly equal parts of carbonate and sulphate of potash, while the gaseous residue is constituted nearly of equal volumes of carbonic acid and nitrogen. Of course the sulphate may arise from the oxidation of sulphide, formed at the outset. Notwithstanding that the ingredients of gunpowder are prepared as above stated, confinement is necessary to prevent the grains from being thrown apart and chilled, so as to prevent the propagation of the ignition, through the congeries forming a charge, by means of the flame of the first portions fired. This was fully demonstrated by the exposure of a pile of gunpowder comprising enough for the charge of a musket, within an exhausted receiver, to a wire intensely ignited by a galvanic discharge. The grains did not take fire instantly, probably because the vapour evolved prevented actual contact; and when ignition did ensue it extended only to the production of a feeble flash. On examination, it was found that a portion of the powder had escaped inflammation.

In the next place, a like weight of gunpowder was consolidated into a cylinder by intense pressure. Thus prepared and ignited, by contact with an incandescent wire in the exhausted receiver, more than half of the cylinder remained unconsumed.

A much larger cylinder of the same mixture, similarly consolidated, placed at the bottom of an iron pot, 4 inches in diameter and 12 inches in depth, on being touched by the end of an iron rod reddened in the fire, burnt at first like a squib, but towards the last was dissipated with an activity in some degree explosive, probably in consequence of the pressure created by the reaction of the gaseous current generated by its own deflagration.

The want of confinement, which is thus capable of lessening the explosiveness of gunpowder, of which the constituents are intimately intermingled, is still more enfeebling, where analogous reagents are ignited together without admixture or comminution. Under these circumstances, the reagents are made to recede from each other by the generation of that vapor or gas, to the evolution of which, under confinement, the capability of exploding is due. Thus sundered, they are chilled by radiation, so that the temperature requisite to sustain and communicate ignition is not supported. Moreover, the rapidity of reaction being as the multiplication of the points of contact, and these being fewer as the substances are less divided and intermingled, the deflagration takes place in detail, instead of having that simultaneousness which is indispensable to render it explosive.

In addition to the ideas above mentioned as having been conveyed in Dr. Hare's letter to Hays, it was urged, also, that his inference as to the explosion of water with incandescent nitre being attributable to a reaction analogous to that represented as taking place when potassium is burnt with the oxide of potassium, was supported by the fact, that a white heat, the base of nitre spontaneously abandons its acid, while from water it cannot be separated by any temperature. Consequently, the presentation of substances, consisting of carbon, hydrogen, and oxygen, by yielding water to the base, could not but be productive of a result analogous to that which results from the presentation of sulphur and carbon.

The only obstacle is as follows:—Substances containing hydrogen and oxygen, whether in the proportion for forming water, like sugar, starch, gum, and wood; or having an excess of hydrogen, like oils and resins; moreover, all the constituents of nitre, even the base, are susceptible of the aëriform state at the temperature producible by the reaction of nitre with them. But when kept together until that point is attained, the explosive power must be fully equivalent to that of gunpowder. The reagents are in a state analogous to that of two gases extremely condensed.

The explosibility of incandescent nitre with water was illustrated in the small way, by heating a portion in a platina capsule by the flame of a hydrogen-oxygen blowpipe, and sudden immersion in the liquid. So active was the explosion, that a portion of the resulting hydrate flew out upon the operator. Yet, when thrown in the same state upon molasses or sugar, no explosion ensued: nevertheless, when a capsule containing nitre heated to the point of volatilization, was struck with the face of a hammer, coated with sugar melted upon it and made to adhere by moisture, a detonation took place; a still more powerful detonation was produced as follows:

Upon an anvil, a disk of paper of 3 inches in diameter, was laid, covered with pulverized sugar. Over the sugar was placed another similar disk covered with pulverized nitre. A bar of iron, rather wider than the disks at a welding heat, was then held over them, and subjected to a blow from a sledge. An explosion, with a report like that of a cannon, ensued.

Instructed by the facts and considerations above stated, it is inferred that the explosions which contributed to extend the conflagration in New York, as above mentioned, arose from the reaction of the nitre with the combustible merchandise with which it was surrounded. It is presumed that as

soon as the fire reached any of the gunny bags, it must have run rapidly through the whole pile, by means of the interstices necessarily existing between them, the nitre with which they were embued causing them to deflagrate. Much of the salt being thus brought to the temperature of fusion, it must have run about the floor, reached the combustibles, and soon found its way to the next story through the scuttles, which were open. All the floors must have been rapidly destroyed by the consequent deflagration, far exceeding in activity any ordinary combustion. Meanwhile, the nitre being all liquified and collected in the cellar in a state of incandescence, and the merchandise conglomerated by the fusion of sugar and shell lac, aided by the molasses, the weight, the liquidity, and temperature must have produced all the conditions requisite to intense detonations. The floors having been consumed, the stores must have been equivalent to an enormous crucible of twenty feet by ninety, at the bottom of which were nearly three hundred thousand pounds of nitre, superficially heated far above the temperature producible by any furnace so as to convert the reagents into nascent aëriform matter under a pressure of half a million of pounds. The intense reaction, however, would not permit of durable contact. At each impact, the whole mass must have been thrown up explosively, and hence the successive detonations. But the chemical reaction, the heat, and the height of the fall, growing with their growth, and strengthening with their strength, the last elevation was succeeded by the thundering report and stupendous explosion, of which it has been an object to afford a satisfactory explanation.*

HOW THE VOTING IN NATIONAL ASSEMBLIES IS (PROPOSED TO BE) MANAGED IN FRANCE.

Each deputy is to have a ball of equal size and weight; at each seat are to be placed two small tubes, and the occupant of the seat drops his ball into one or other of these, according as he wishes to vote, *aye* or *nay*. Under each of the corridors which separate the ranges of seats are placed two larger tubes, extending from the extremities of the hall, into one of which open all the tubes destined to carry the affirmative, and into the other those destined to carry the negative votes. These tubes are established with properly calculated slopes, so as to bring the balls certainly and rapidly along with them, and each terminates in a counterbalanced reservoir; the adjustment of which allows the appreciation of all weights from that of a single ball up to that of 900 (the number of votes in the assembly.) Each reservoir acts upon a separate index-hand (that for the affirmative votes being white, that for the negative black) which moves over a semicircular dial sufficiently large to be divided into the requisite number of parts, easily visible from all parts of the hall. The position of the hand will then at once indicate the number of votes, *aye* and *nay*.

FIRST TRIAL OF BARON VON RATHEN'S COMPRESSED AIR LOCOMOTIVE CARRIAGE ON COMMON ROADS.

We have several times taken notice of the compressed air locomotive carriage, which was in the course of construction in the workshop of the College of Civil Engineers, Putney, according to the plans, and under the immediate direction of, Baron Von Rathen (see vol. xlvi., p. 576, vol. xlvii., p. 93, vol. xlviii., p. 61.) We have now the pleasure of announcing that it has been at length completed, and an experiment made with it on the common highway, which, though not exempt from the mischances so common to first trials, is sufficiently encouraging.

This first trial was made on Wednesday last, on the road between the College and Wandsworth. The carriage travelled the distance (about one mile) from beginning to end with an uniform and regular speed of about eight miles per hour; and an attempt (as we understood) was then made to increase the pressure, in order to attain a speed of 10 or 12 miles, when, unfortunately, some of the tubes of the air reservoir, which had been worked in the course of last week to a very high degree of pressure, and thereby much injured, gave way, and exploded, (happily without injury to any one).

Nevertheless, we may consider the problem of the practicability of obtaining an uniform working power, from compressing air in large quantities, and to a high degree, to have been thus determined in the affirmative. Though the degree of speed safely attainable is a point yet to be ascertained, it is a great deal to have established the principle that compressed air *can* be made practically available as a motive power, and is but dependent on mere soundness and strength of materials for a large measure of success.

* In a short time a more circumstantial account of Dr. Hare's experiments and inferences respecting the subjects of the above communication will be published.

GRESHAM PROFESSORSHIP OF GEOMETRY.

The Gresham Professorship of Geometry was held for the last forty years by Dr. Birch. This gentleman lately died, leaving Gresham College pretty much where he found it as to literary celebrity, though somewhat altered in its locality. The electors have supplied the loss by the appointment of Mr. Edkins, the son of a common-councilman, who (the son we mean) distinguished himself at Cambridge as twenty-fifth senior optime and sixty-fifth man of his year, eighteen years ago. His competitors were Professor Moseley, Mr. Cowie, a senior wrangler, Mr. Potts, the author of the best English work on geometry of this century, and some others. We augur great things from a gentleman who is preferred to others apparently so much his superiors; and our prognostications are yet more sanguine when we remember that he, at his accession, is as well known to the scientific world as his predecessor was after forty years' tenure of the chair of Briggs, Barrow, and Hooke.

Our contemporary, the *Mechanics' Magazine*, has fished out the preceding facts. This journal, which has taken up the subject with meritorious warmth—for really Gresham College is a disgrace to modern civilisation—offers to retract its censures if one single witness, who knows the difference between Taylor's theorem and Christie's, will say that he has gained from the Gresham lectures on geometry any single idea which was not as common as flints in a chalk-bed. We are afraid that our contemporary has here committed himself; and we should like to play the part of the friend who used to institute a suit in Doctors' Commons in certain cases of marriage within the prohibited degrees, thereby to hinder an enemy from doing it. We really have some idea of Taylor's theorem, and could get it up in time for the hearing; though, what Christie's theorem is, we do not know,—we suspect our contemporary has some joke on his anvil. But, if we can qualify, we should then proceed to say, that we once heard two men talking about the Gresham lectures,—and one of them told the other that happening to stray into a Gresham lecture-room while the professor of geometry was waiting for an audience, it so fell out that his entrance made a quorum. The professor was, therefore, obliged to read, which he proceeded to do from a paper containg a lecture on the properties of *flame*, with substantiatory citations from Aristotle! Now, surely such ideas are not as common in geometry as flints in a chalk-bed.

Our contemporary declares that he will endeavour to form an audience for Mr. Edkins, and report his lectures. This is the right way;—audiences and publicity would have set Gresham College on its legs again long ago. A committee of public-spirited individuals, who would subdivide into sections, entitled "Quorums for the supervision of the Gresham Breach of Trust," and act up to their name, would deserve thanks. But our contemporary seems to have some notion that his plan is to act by shaming the Corporation of the City of London, in which idea he seems to us to be as sanguine as Mr. Pickwick, when he thought he could abash Dodson and Fogg. No, no!—Mr. Edkins will be led to such research and reading as will fit him, at least, for his ordinary duties long before the spear of our contemporary will find a weak place in the shell of the city turtle. We recommend to the new professor to beatir himself; and as he has gained his position to the exclusion of men of a much higher caste, let him acquit himself of being an accomplice before the fact by showing that he does not mean to be one after it. Let him make up his mind to retire in favour of his future self; and in the meantime, let him enjoy himself in training his successor.

Our contemporary seems to take for granted, that by *geometry*, was meant geometry as distinguished from other parts of mathematics. We, on the contrary, are persuaded that mathematics in general were intended. It was our purpose to have argued this point; but we desist, from a conviction that, until the arrival of better days, it matters nothing whether Sir Thomas Gresham meant geometry or gymnastics. It is useless to settle the places for meat and bread in an empty pantry, particularly when we know that neither butcher nor baker has received an order.

The time must come when the funds given to the advancement of mankind by the noble citizen shall cease to be the private patronage of a few illiterate liverymen. The Corporation of London is strong—but there cometh a stronger.—*The Athenæum.*

WEEKLY LIST OF NEW ENGLISH PATENTS.

Duncan Mackenzie, of Goodman's Fields, manufacturer, for certain improvements in Jacquard machinery for figuring fabrics and tissues generally, and apparatus for transmission of designs to said Jacquard machinery, parts of which are applicable to playing musical instruments, composing printing types, and other like purposes. (Being a communication.) August 5; six months.

David Newton, of Macclesfield, Chester, merchant, for certain improvements in the application of glass and glazed surfaces to nautical, architectural, and other similar purposes. August 7; six months.

Samuel Thornton, of Birmingham, merchant, and James Edward M'Connell, of Wolverton, Buckinghamshire, engineer, for improvements in steam engines, and in the means of retarding engines and carriages on railways, and in connecting railway carriages or waggons together; also improvements

in effecting a communication between one part of a railway train and another, by signals or otherwise. August 7; six months.

John Metcalfe, of Little Bolton, Lancaster, machine maker, and Robert Halliwell, of the same place, mechanic, for certain machinery or apparatus for preparing and spinning cotton and other fibrous substances. August 8; six months.

Moses Poole, of London, gentleman, for improvements in the manufacture of casks and other similar vessels of wood. (Being a communication.) August 8; six months.

Samuel Lees, of the firm of Hannah Lees and Sons, of Park Bridge, Lancaster, iron manufacturer, for certain improvements in the manufacture of malleable iron. August 8: six months.

Joshua Cooch, of Harleston. Northamptonshire, agricultural implement maker, for improvements in sackholders. August 10; six months.

William Thomas Henley, of Clerkenwell, philosophical instrument maker, and David George Foster, of Clerkenwell, aforesaid, metal merchant, for certain improvements in telegraphic communication, and in apparatus connected therewith, parts of which improvements are also applicable to the moving of other machines and machinery. August 10; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Aug. 4	1526	Thomas Burnham Clark, Lawrence	Poutney-lane, London	A direction label.
5	1527	John Brown	Sheffield	Conical spring for railway carriages made of round, square, oval, hexagon, or octagon steel.
7	1528	John Robert Grover	Castle-street, Holborn	Letter paper.
7	1529	Thomas Porter	Strand	Shirts.
8	1530	Thomas Dinmore	Liverpool	Tassel fastener for brooches, clasps, buttons, &c.
,,	1531	Charles Twigg	Birmingham	A sewn-through shank papier mâché button.
,,	1532	Robinson and Fussell	Mill Wall Works, Poplar	Wrought iron railway wheel.

CONTENTS OF THIS NUMBER.

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MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1306.] SATURDAY, AUGUST 19, 1848. [Price 3*d*., Stamped, 4*d*.

Edited by J. C. Robertson, 166, Fleet-street.

A GOVERNABLE BALLOON.

Fig. 1.

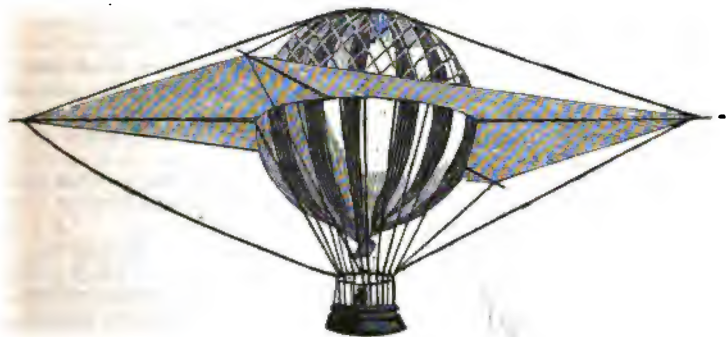


Fig. 2.

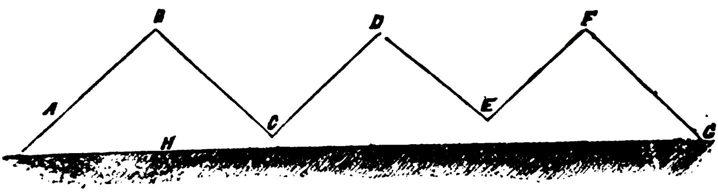
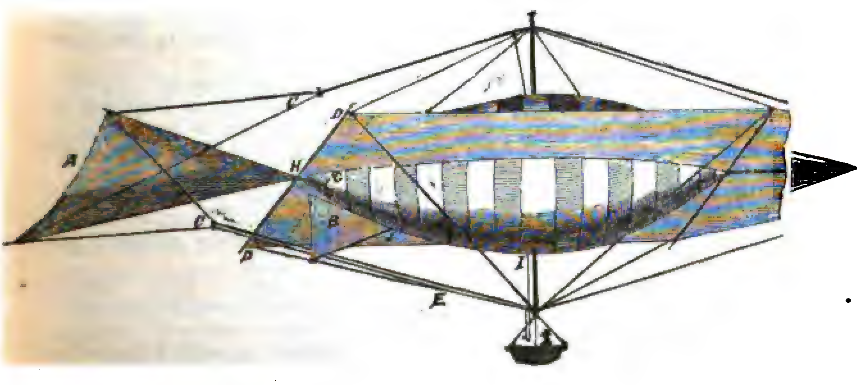


Fig. 3.



PLAN OF AN AËRIAL LOCOMOTIVE OR GOVERNABLE BALLOON.

A BALLOON possesses a principle of motion independently of any mechanical contrivance, or other means, than gas and ballast; that is, a motion upwards when it displaces a greater *weight* of air than itself, and downwards when it displaces a less weight. It possesses this in common with other things—for instance a bullet, but this motion is only simply up or down. Put, however, a bullet on the top of an inclined plane, and its motion becomes diagonal. Now, let us apply this to a balloon. To produce on the balloon a similar effect to that of the inclined plane on a bullet, let us add to a common balloon a kind of horizontal sail (of which an idea may be formed from fig. 1) with some contrivance for inclining it as required (for the *contrivance* see further on). Let it be required to navigate the balloon from A to G, fig. 2; incline the sail up towards B (the gas and ballast are in a proportion productive of an upward tendency). Arrived at B, or the equilibrium elevation of the balloon, let out some gas, which will give it a tendency downwards, and incline the horizontal sail down towards C; arrived at C, throw out some ballast, and incline the sail up towards D; and so on till you reach G.

If there is any wind, the balloon must besteered as if going so much to windward of your destination as the wind would carry you in the same time.

So far good; we have got the means of going from A to G: let us now turn our attention to increasing the speed of the balloon. Towards this end, let us make the "Ethereal Argo" something resembling the "Oceanic Argo" in form—in other words, make the balloon approaching to ship shape; perhaps something like fig. 3, with a "tail" A, to give the inclination when required, worked by ropes, CC, which pass through blocks in the upright spar, thence to a man in the car; and a rudder, B, to point the machine to the quarter required, which may be worked in a manner similar to the tail, by ropes passing through blocks fixed to DD, (not shown in the figures to avoid confusion;) and as, in the arrangement I have made, CE interferes with the rudder, B, I have put two ropes, either to work the tail with, as the other may require to be slackened for the play of the rudder; also the rudder might be fixed at J to a spar passing from H to I.

I cannot resist the temptation to go a little further in this ramble of mine after Dædalus.

To fig. 3 I think we may add a couple of screw fans, perhaps in the places dotted off, DG, DG, to be worked by a connecting gear by a man in the car. Experience must show if a machine sufficiently large to carry the gear and a man could be made to "go" to any purpose or not, by the sole labour of that man.

Having gone so far, why not go further and make a monster machine at once to be worked by an engine? Of course ether would be better than steam. In this last case the fuel will do admirably as ballast (see commencement of this); you might steam up AB, let out gas and run down BC, steaming up CD and C. In steaming up, each ounce of fuel consumed would help you up more easily.

The machine in this last form, I consider as a combination of Henson's and Pitter's plans.

Atmospheric air is made to raise a balloon by heating it: could not some of the gases used to raise balloons without being heated, produce a much greater effect by being heated?

The spread of the horizontal sail might be made reducible as the weight of fuel diminishes, or they might be made to collapse.

After all, Mr. Editor, these are but mere hints; but I hope there may exist some enterprising person to *take* them and prove them *hits*.

It was seeing Mr. Pitter's "Archimedean" in a number of your Magazine for June, 1847, (only just to hand from an accidental delay,) that has encouraged me to send you the foregoing.

We have got very near the maximum of speed on land and water, whereas in the air it is yet scarcely suspected that we can "go" at all.

Mr. Pitter makes a slight mistake when he says that increasing the size of the balloon would render the machine "ungovernable;" it would not alter the power of governing the machine's motions, as regards their direction, in the

least—it would merely diminish their speed. The balloon is not like a ship in this respect; the latter is half in one element and half in another, and can as it were lay hold of the one to direct a motion caused by the other. A balloon cannot "beat," having nothing to "lay hold of" foreign to the air, which carries it along—and it is only in beating, a vessel can become ungovernable.

I am, Sir, yours, &c.,
EDMUND HUNT.

Batria, May, 1848.

ON THE MEANS OF FASTENING TOGETHER THE COMPONENT PARTS OF VESSELS FOR NAVIGATION. BY THE LATE BRIG.-GEN. SIR SAMUEL BENTHAM, K. S. G.

(Concluded from page 154.)

Bolts.

The greatest improvement in regard to bolts is the forming them with heads, to rest against metal plates when driven home, and the cutting of screws on their points, with nuts to screw upon them against plates of metal. By screwing the nut up tight, the bolt may be made in the first instance to draw parts together as closely as required; and also (which is of great importance) to afford at any future time means of drawing together any parts that may have become loosened, either by the decay, contraction, or wear of the substance of the parts connected; or by the elongation of the bolt itself. This mode of bolting parts together in machinery, engineering and house carpentry, has been long practised; and it evidently would afford no less efficacy in connecting together those parts of a navigable vessel to which bolts are applicable. I proposed this improvement to the Admiralty in the year 1805, and at the same time caused the tools requisite for the perfect formation of the screws and nuts to be applied to His Majesty's dock-yards with the sanction of the Lords Commissioners. The bolts used for the *Fame* were prepared by this apparatus, but I believe the tools for this purpose, like those for the stepshaped treenails, have remained forgotten.*

It has already been proved that the great quantity of copper at present employed for fastenings is unnecessary; since, in the instance of the seven vessels built under my direction, no bolts were used for fastening the plank; excepting that short copper screws were employed at some of the butt ends of it, it was fastened by treenails alone. On the close examination of one of these vessels, the *Dart*, after seven years' service at sea, during which she had been in several engagements, the plank of her bottom was found, as above mentioned, to have remained close to the ribs notwithstanding the most severe caulking had been employed—a circumstance very unusual, if not unprecedented in regard to ships of the ordinary construction.

Screws.

General as is the use of the screw in all works of wood in civil architecture, and for the joinery on board ship, this cheap and efficient fastening has been little used in naval architecture.

As to the particulars on which the efficacy of this fastening depends—the cylindrical part of a screw gives it stiffness near the head, and after it has passed through one of the pieces to be connected together, as also a little into the other, the thread upon the tapering part gives it there extension breadthwise; and that in a manner of all others wounding the wood in the smallest degree, since the thread being held by the fibres whilst passing between them and the stem being very small, the thread gives extension breadthwise by the hollow helix pressed into the wood, of the size, and no more than the size, which that thread will fill up. Again, the intermediate helical projection of the wood retains the thread of the screw in its place against all forces tending to draw it out.

The efficiency of screws for ship-work has been manifested in the cases where they have been employed for fastening the butt ends of the plank, both of the decks and the bottoms of the vessels abovementioned.

Common screws of metal, when of

* From information recently afforded, it appears that this improvement is not yet adopted in Her Majesty's dock-yards. In the year 1805, Sir Samuel's success in naval architecture was perceived by the Admiralty, and his improvements were beginning to be introduced generally, when he was shortly afterwards selected by the Government for a mission to build ships for our service in Prussia; on his return home the abolition of the Office of Inspector General of Naval Works deprived him of the means of prosecuting improvements in naval architecture. June, 1848.

large diameter, have the disadvantage of great specific gravity, and of great expense if of copper or mixed metal. To obviate these objections, I contrived screws of an entirely new make. When intended for screwing on the butt ends of plank, they had stems just so long as to pass through the plank, and to enter an inch at least into the timber; their efficiency in this part depending on their size, they were made large, but for lightness and cheapness, hollow, whilst the sharpness and depth of the thread of the screw, formed on its diminished point, enabled a small length to answer effectually the purpose of a secure fastening. The hollow of the stem received the tool used for the insertion of the screw, and was afterwards filled in with a plug of wood. These screws, however, though perfectly well suited for their intended purpose, have scarcely to this time, I believe, been employed, except in the vessels of my construction.*

Screws would be well adapted to the fastening many interior parts of a ship, or ribs or beams of metal to the planking; the more so, as by their means no hole need be pierced through either the bottom or the sides.

The particular forms of screws that would be most advantageous for the fastening different parts of a ship are not yet ascertained, nor whether copper or a composition of metals would be the most suitable material for them; and as the tools for preparing holes for the reception of screws admit of great variety, this subject is well worthy of the institution of a set of extensive experiments upon it.

Screws of Wood.

Screws of large diameter made of tough wood, would be found, no doubt, in many cases an efficient fastening.

Plates and Straps.

Plates, or straps of metal applied on the outside of pieces to fasten them together, are occasionally used where the fastening by bolts is objectionable, either on account of the great length of those required, the impediments there may be to the driving them in, or to the riveting their points, or the screwing on nuts to them. There are also some cases in which a given quantity of metal in the form of plates or straps would better resist the strain than in the form of bolts; as, for instance, in cases where the strain would act not so much to draw out, as to bend the bolt driven as usual through the parts to be fastened. The efficiency of straps to resist such a strain would be the greater, the farther those on opposite sides were from each other.

For fastening the knee of the head, as also the dead-wood to the stern along the rising line, where there is no piece like the stern-post to serve to steady it, straps on the outside appear, at least in the first instance, capable of being made a more suitable fastening than bolts. So also, to hold two parts together where the plates or straps can be applied at a certain distance from each other, they would form an efficient fastening; for example, on each side of a beam, the strap extending to a considerable distance from the point of junction of the parts to be connected, one end of the strap to some feet along the beam from the side, the other end of the strap at the side some feet below the beam: by such means the rocking motion would be prevented, which tends to alter the angle which the deck makes with the side. The form of such plates, although broad and thin where they are connected with the beam and with the rib, should in the intermediate part be of a form and thickness suited to give stiffness, and to resist a thrust as well as a pull.

The efficiency of plates, or straps, must evidently depend both on the strength of the plate itself to resist the thrust or strain applied to it, and on the perfect combination of the plate with the surfaces of the pieces to be joined. In this view, plates, where used, are not only extended far enough beyond the juncture of the pieces they connect, to afford room for the insertion of a sufficient number of nails or screws, but the plates themselves are often let their whole thickness into those pieces; and often, instead of extending in a straight direction, are made to branch off in the form of a T, or otherwise, in order to take the better hold of the pieces to be com-

* Nor are they yet employed in the Royal dockyards, 1848. In regard to these hollow-headed metal screws, Sir Samuel happened to inquire about them of a Surveyor of the Navy, when he learnt that those furnished as models had been put into a drawer at the Navy Office and forgotten.

bined: but the expense of this additional quantity of metal, and complication of form, in addition to the increased quantity and accuracy of workmanship required, render this mode of combination in many cases objectionable, in comparison even with the simple boat; and a general inferiority of such plates or straps to screw-pointed bolts, is that neither plates nor straps afford means of tightening up when requisite, in consequence of contraction of the wood, or elongation of the metal.

Whenever plates are required to be let into the wood—which in many cases is very advantageous, in order that they may take the better hold of it, and to prevent the level separation of the pieces—it would be desirable that they should be let in by a tool insuring accuracy; therefore the plates should terminate in a circular form, so that the indentations to receive them may be cut by a boring tool.

Nails.

In regard to nails, it might be supposed that experience in a fastening so universally in use, had long ago pointed out the forms best suited to the different cases in which they are employed. The fact is, on the contrary, that the form of nails in general use, from the smallest tack to the largest spike nail, is very objectionable. They are made tapering from the head to the point in *both* directions pyramidically. This form, although easily driven into wood, is a form ill fitted to hold firmly in it, besides being very liable to split it in driving; whereas, a form tapering only in thickness, and left, chisel-shaped, as broad at the end as at the head, is, of all simple forms, that which affords the greatest resistance to the strains tending to draw out a nail; and if, in driving, the point be placed breadthways across the fibres of the wood, so as to cut them, but not divide them longitudinally, such nails hold much faster than if inserted with the grain, and do not split the wood. It is more than fifty years ago that the advantages of this chisel-form for nails in general occurred to me; and they appeared to be so great, that I pointed them out on many occasions to workmen of different descriptions, in other countries as well as in this: they were well convinced of the truth of my observations, yet nails for general use have still continued to be made of the objectionable pyramidical form.*

It is true, however, that chisel-shaped nails have been long in use for some few particular works, as for fastening the strakes together in the construction of boats by clinch-work. I caused the sheathing nails to be so made for my experimental vessels,† and of late years, at my suggestion, cast mixed-metal bolt-nails, thus formed, have been in general use in the Royal dock-yards; but otherwise, this superiority of form has been, in the construction of vessels, disregarded.

There are, however, some few cases where facility in drawing out the nail is desirable, and there the pyramidical form is advantageous; as, for instance, for tacks for nailing a carpet to a floor.

Besides nails of the simple form, nails jagged, barbed, or twisted, have been at times proposed and tried, but are not in general use, except that carpenters sometimes jag the nails by hand for some purposes where a particular degree of tightness is required. A barbed nail has the advantage of spreading the surface with the smallest quantity of material. Twisted nails would be particularly advantageous in soft woods, into which they might be forced by simple driving, the nail, as it enters, turning in the wood, so as to hold in the manner of a screw.

* The above was written in the year 1830. Of late, some nails for common use have been found to be chisel-shaped; and cast-iron nails have been frequently so shaped of late in France; but the general form for nails in commerce is still pyramidical.

† Nails like those employed for the experimental vessels, were afterwards ordered for general use in the dock-yards; and, as they were subsequently discontinued, it seems proper to give Sir Samuel's own statement on the subject; it is as follows:—"In respect to these nails, however, it must be observed that they, having been ordered for general use," (in 1803 and 1804,) "were found, whilst I was in Russia, to have dropped out of some ships of the usual construction, and the use of them was, therefore, discontinued; but I have not, since my return, been able to ascertain distinctly whether this failure arose wholly, as I suspect, from the employment of a punch for perforating the holes which was much too large for the nails, and from the imperfect workmanship of the nails themselves; or whether from the working, through weakness, of the ship of the usual construction in which they were used. But, supposing the punch to have been suited to these nails, and the nails themselves to have been well made, there can hardly be afforded a more convincing proof of the superior strength of the vessels of my construction, since, in all of them, no other sheathing nails were used: and they were found to have answered their purpose most perfectly for securing the copper on to planks of fir, elm, and beech, as well as of oak.

The heads of nails are variously formed, some very small, as that of the brad, so as to be driven in even with the surface of the wood; others with heads more or less broad extending over its surface, thereby preventing the nail from being driven into it, as also for fastening metals to wood, in which holes are previously made for that part of the nail which is to go into the wood, but which can only retain the metal in its place by the extension of the head of the nail beyond its hole.

Where a metal surface is required to be smooth, a mode very generally in use is countersinking the metal, that is (as in hinges) preparing in the surface of the metal an indenture for the reception of the head of the nail. Of late years a similar expedient has been adopted in nailing copper sheathing on to vessels; that is, by forming, by means of the punch, an indenture in the copper to receive the head of the nail.

As to the material of which nails are formed, the considerations requisite regard chemical as well as mechanical properties. The mechanical properties required are sufficient tenacity to prevent their being broken, and sufficient flexibility to admit of their being driven without bending. The chemical properties requisite are variable, according to the wood into which the nail is to be driven, and to the metallic substances with which it is liable to come in contact, especially when wet. The acids in oak, particularly, frequently decompose iron inserted into it; and the oak is, in its turn, destroyed by the iron. Galvanic influence on different metals in contact, when wet, has long been observed, and has occasioned the practice of using iron fastenings for iron, and of copper or zinked metal for copper. There is a reason of economy which points out that pure copper nails should be used for fastening copper, particularly in sheathing; it is this, that when the old copper comes to be remanufactured, the expense is saved of picking out remaining portions of nails, since, if of mixed metal, and remelted with the sheathing, they either injure its quality, or occasion extra expense in refining the copper.

Hoops.

Hoops of metal, surrounding the exterior of pieces to be held together, are much used for combining the pieces to form what is called a made mast. This kind of fastening is known to be very efficient as applied to a cask, in resisting the great force of the staves when they swell by the absorption of moisture; but when the pieces of wood which a hoop surrounds, shrink in becoming dry, it no longer holds them tight. The continued efficacy of hoops in such a case must, consequently, depend on the means provided for tightening them, whenever the dimensions of the wood are contracted. This tightening, in the instance of a cask, is effected by forcing the hoops up or down on to a larger part of the cask; it may also be effected by forcing some additional matter between the hoop and the pieces it is required to combine. Where these means are not suitable, instead of an entire hoop, a curved metal bar is passed round the piece to be secured, so that the ends of the bar may remain at a little distance from each other, and so shaped as to admit of being drawn closer together, so as to complete the hoop by means of screw-bolts, or by wedges driven into eyes or mortices formed at the ends of the bar. In these cases it is evident that the pieces employed to hold the ends of the bar together, require to be as strong against tension as the bar itself. Such hoops are applied to masts in cases where entire hoops would not be suitable.

Tabling, Dovetailing, &c.

Fastening—by shaping the contiguous parts of pieces to be joined together in such manner, as that portions of those pieces shall enter partially one into the other in the form of what is termed dovetail, tenon, tabling, rabbeting, tongueing, grooving, and morticing.

By cutting a projection on one piece of wood, and by cutting a corresponding indent in the piece to be connected, it is evident that an efficient mode of juncture may be effected always against sliding, sometimes also against separation. By making the form of the projection what is called a dovetail, two edges may be thus connected together so as to act against both sliding and pulling asunder. By tabling, that is cutting quadrangular indents, and leaving similar projections on one surface, and by cutting corresponding projections and indents on the other piece to be connected, it is evident

that an efficient mode of juncture may be effected against sliding, sometimes also against separation, by the insertion of the projections into the indents in the pieces reciprocally—so that one or both of these purposes is answered by the various ways in which projections and corresponding indents are made.

Tabling has been much used in shipbuilding in the connection of different parts of a ship, besides that of the made mast, as for putting together the scarphs of beam pieces, for fastening knees to beams, &c. There are, however, two objections to this mode of fastening. One is the expense incurred by the waste of the substance of the wood, often particularly costly when the pieces are large, and by the quantity of workmanship necessary in cutting the projections and indents; the other, and more important objection is, that when extreme accuracy of workmanship is not attained, and which it is very difficult to attain in the most important cases, the effect of preventing sliding is not produced; the fastening consequently fails of its intended purpose, besides which moisture often insinuates itself into the interstices and rots the wood.

These objections are all of them obviated by the employment of the before-mentioned *coques*, since, where they are used there is no waste of timber, the workmanship is easy, expeditious, and little costly, its accuracy being accomplished by means of tools, independently of any particular skill or care in the workman, and the tightness with which the coque fits into the holes prepared for it, secures the part against any intrusion of water or moisture.

Cements.

Cements are rarely, if ever, employed in naval architecture. The interposition of glue between parts to be joined is effectual where they are to be kept always dry, the wood itself often tearing asunder rather than the yielding of the glue; yet the unfitness of it to resist moisture, and the unevenness in many cases of the surfaces of the component parts of a ship, render this cement inapplicable as a fastening in shipwork. But were the timber for the construction of vessels to be seasoned by artificial heat and ventilation, were it kept dry till inserted in the vessel, were the structure carried on from its commencement to completion in a building, so as to be protected from moisture,* even common glue might in some cases be used with advantage for perfecting many more junctures than those where it is actually used. Besides this, improvements might be made in the composition of glue by the use of caoutchouc,† or other substances resisting moisture. In many cases other matters little subject to decay might be advantageously employed, were it only for the exclusion of air and moisture, and for the filling up all vacancies between the parts to be combined together.

Enumeration of various new tools for shipwork, contrived by Sir Samuel, but not brought into actual use:

1. Guides for boring holes from the opposite sides of a piece of timber or metal, so as to be sure of the holes meeting.

2. Screw cramps for drawing planks close to the timbers, and holding it while fastening.

3. Large borers for cutting out large holes in topmast-caps, bowse-pieces, &c.

4. Screws for drawing out bolts.

5. Screws for the temporary fastening of the plank until the treenails are driven: different from the screw cramps, No. 2.

THE HOUSES OF PARLIAMENT.

Some time ago we ventured to step a little out of our usual track for the purpose of animadverting pretty freely upon Mr. Blore's doings at Buckingham Palace; for doing which we did not at all incur the displeasure of our readers and correspondents, or if we did they kept their displeasure to themselves; where-

* As, for instance, the wood dried in such a seasoning house, and the ship built in such a covered dock, as Sir Samuel designed and proposed in the year 1812.

† For various uses to which caoutchouc might be employed in naval architecture, see Sir Samuel's "Naval Essays," Essay the first, p. 134; published by Longman, 1828. Such a cement as that indicated seems now to be in considerable use, under the name of marine glue.

On one occasion when Sir Samuel was at Portsmouth, a small French prize, *La Sophie*, was in the dockyard for repair; on taking off her sheathing, it was found that under it her bottom had been coated with a calcareous cement, combined with oil, and in some degree elastic; it was still water-tight, so much so, that on piercing it, bilge water flowed from the inside through the seams between the planks.

fore we are at liberty to suppose that an occasional deviation of the kind is not deemed by them an unpardonable offence, if even one at all. Encouraged by this implied approbation, we once more " venture to intrude" with a few remarks on a cognate subject, namely, the architectural merits of Mr. Barry's New Palace at Westminster, which is now occupying some considerable share of public attention in consequence of a very able criticism upon it which appeared in the last Number of the *Westminster Review*. A writer in a contemporary Journal (the *Builder*) who has taken upon himself the defence of Mr. Barry, calls the article in question an "ill-natured one." Most assuredly it does not at all flatter Mr. Barry, yet it hardly, therefore, follows that it is a mere effusion of ill-nature. For our own part, we do not hesitate to give it as our opinion, that the reviewer has not been, by many degrees, so severe upon Mr. Barry as he might have been. What he says goes only to accuse the architect of want of discretion and judgment, and good taste. He blames him, not without reason, for overloading the exterior of the building with such a profusion of minute and elaborate embellishment that all repose is destroyed. He has not, however, brought forward against him, two circumstances which are not at all calculated to reconcile us to such excess of elaborate decoration, even were it not otherwise objectionable, viz., that, first, owing to its unfortunate situation and aspect the details of the river front (the principal one in the general design) can scarcely be made out at all —certainly not be seen at all as they are intended to be, and perhaps really deserve; secondly, that whether considered in itself, it be perfectly in good taste or not, this exuberance of decoration has occasioned an unpardonable, because altogether prodigal and useless expenditure—a most wasteful outlay of public money—wholly unproductive of aught like corresponding degree of effect, or of enjoyment to the public. If it be satisfactory merely to know that the work is highly creditable to all the respective artificers, and highly deserving examination, that satisfaction the public will certainly have; though whether it will be satisfactory to have to pay for what, excellent as it may be in itself, can scarcely be seen at all, may very well be doubted. Hitherto, in public matters of the kind, we have generally proceeded upon a false system of economy; and now, determined for once to be liberal, we are going upon an equally false system of liberality in regard to the Houses of Parliament, which the nation makes its "miser's feast." After having starved many of our most important public buildings, we are now cramming that edifice to excess. While the whole of the west side of Somerset-place is left to present to the eye a mass of architectural beggary along that side of Wellington-street, although any façade there would display itself to the greatest advantage, on account both of favourableness of aspect and very peculiar favourableness of situation, the river front of the "Houses," which can never be otherwise than very imperfectly seen, and which labours under great disadvantage with respect to aspect, is bedizened out in the most extravagant manner.

Had it, indeed, been discovered that the original estimate would amply cover ultimate cost, superfluity of decoration would have been excusable enough. But to indulge in it, after the disagreeable discovery, that the works have already exceeded that estimate by nearly as much again, is somewhat preposterous. Unless retrenchment should now take place with regard to all that remains to be done, this single edifice will cost the country at least three times as much as was at first contemplated. Twelve years ago, Mr. Hume told the House, "he firmly believed Mr. Barry's plan would be double the estimate." Mr. Mackinnon went even further, and said, "If things are allowed to proceed at this rate, two millions will not cover the expense." Surely, when the architect found at what prodigious rate he was going, he might have attempted to slacken it, which, so far from diminishing speed as to time, would have very greatly accelerated it, since, but for the time occupied and labour consumed in elaborating portions of the exterior, where such elaboration is thrown away, other parts, which are not yet begun, might by this time have been considerably advanced — perhaps completed externally. The *Westminster* Reviewer complains of slowness of progress with the works; but the enormous deal of work which has, very unnecessa-

rily, been put into the building, sufficiently accounts for its apparently slow advance. What to us is most strange is, that notwithstanding his evident desire to find fault with the design itself, the reviewer is so far from affecting to be scandalized at the prodigious excess of expenditure beyond the estimate, that he says nothing on that head.

If architects' estimates are merely *pro forma*—a preliminary ceremony of no more service than that other one of laying what is called "the first stone"—they had better far be omitted altogether. Employers might still deceive themselves as to ultimate cost, but they would not have the mortification of being duped by others—though, for "mortification," we should, perhaps, say pleasure, because

"The pleasure is as great
Of being cheated as to cheat."

And, surely, there must be something particularly pleasing to employers—whether they be the public or individuals—in the present system of estimates, or else they would correct it, as might very easily be done, if only by limiting the architect's claim to a per-centage upon the sum named in his own estimate. That would be no more than fair; and, in some cases, even that claim ought to be considerably abated;—for instance, where the estimate is greatly exceeded—to the amount, perhaps, of half as much again, or upwards. Why should architects be allowed to profit by their own miscalculations? If they arise merely from error on their part, they ought cheerfully to submit to some diminution of emolument; on the other hand, if they are intentionally computed very far below what the architect himself plainly perceives will be the ultimate cost, they are no better than fraudulent deceptions, and ought to be visited accordingly. It certainly does not say much for the honour of the profession, that grossly erroneous estimates—to give them no worse name—should be of such frequent occurrence; and it is exceedingly curious, moreover, that *mistakes* of the kind are invariably on one and the same side. Were they mere mistakes—*bonâ fide*, *honest* mistakes—the error would sometimes *chance* to be on the other side, and would be attended by the agreeable surprise of finding the work executed for less, instead of always more than the estimate bargained for; and if it were also executed satisfactorily, the architect would be well entitled, if not to the whole of the difference, to something handsome beyond his per-centage. Unluckily for employers, blunders of that kind are never committed by architects.

For the "Houses of Parliament," Mr. Barry's original estimate was not in round numbers, with a liberal allowance for unforeseen contingencies, but the specific sum of £724,986—a degree of exactness truly marvellous, considering the magnitude and nature of the work. He might just as well have set down also a few odd shillings, pence, and farthings. The utter impossibility of attaining to anything like exactness, ought to have caused people to suspect a good deal of inaccuracy to be lurking under the pretension to minute accuracy. No doubt a very noble edifice—one that would have been a credit to the nation—might have been erected for £700,000, or even less. But that Mr. Barry's designs could not be realized for that, or anything like that sum, might have been perceived; and had careful consideration been given to the matter, it could not have failed to be foreseen also that a great deal which showed so well in the drawings, would not show at all in the building, if only in consequence of its unfavourable situation. Nearly the whole of the minute and profuse enrichment bestowed, or, we might say, squandered away on the river-front, might have been omitted without the slightest diminution of the general effect from any accessible point of view. As that has not been done, it now remains to provide for, as a *pou sto* from which we can contemplate at leisure, and in an ecstasy of admiration, all the highly finished details and elaborate embellishments of that most unhappily situated façade.

In excuse for the position of the Victoria Tower, the *Builder* remarks, more *naively* than acutely, that such position for it was dictated by the plan adopted by Mr. Barry. This, as it appears to us, is only shifting the objection—and not very skilfully either—instead of removing it. On the contrary, the defect complained of, is admitted to be one, but is discovered to be owing to the—plan of the edifice! Wonderful discovery truly! Most persons will then say that the plan itself is so far defective, and that Mr. Barry should have studied to arrange it

better. At any rate, if he found it impossible to bring in the royal entrance anywhere else than at the south-west angle of his plan, there was no occasion for marking out its situation by carrying up over it, as he purposes doing, a lofty and very massive tower, which, if ever erected, will be a most conspicuous object, from whatever point of view the "Houses" are beheld; nor can the *eccentricity*, as it may justly be termed, of its situation with regard to the rest of the pile, fail to destroy the general balance of parts, and be at variance with the studied regularity of composition observed for the principal or river-front.

By way of further warding off objection with regard to the Victoria Tower being "at what is, and always must continue to be, the most remote corner," Mr. Barry's champion says, there is no "*must*" in the case. Yet, surely, there is not even the very *remotest* probability of the building being ever extended further westward, it being now all but an utter impossibility to do so, the south front and the south and west sides of the Royal Porch being already finished; therefore, how any additional range of building can be joined on to what is already built, we do not perceive. It certainly could not be done without blocking up the arch on the south side of the porch. Done it might have been at first, by making the porch the centre feature of a façade carried on westward for the same distance as the line of frontage runs eastward, nearly up to the south end of Westminster Hall, where there will be a break in the plan. And had that been done, there would then have been a regular façade along that line, very nearly 800 feet in extent, with the Victoria Tower and porch in the centre of it. At least, that tower would have been the focus of a regular and well marked composition, distinct from the other line of building on the same side of the plan, intended to inclose Westminster Hall and New Palace Yard.

As to the authorship of the article in the *Westminster*, it is now no secret that it is from the pen of Earl Lovelace, who shows himself to be a more than usually able architectural critic.

THE GYMNOTUS ELECTRICUS.

Sir,—I lately heard a lecture by Mr. Faraday, in which he told us a little about that wonderful fish called, I think, gymnotus electricus. He said that this fish, after giving a shock to its prey, turned round *very gently*, and drew its prey into its mouth without any apparent effort, and in quite a disdainful manner. He said a good deal which made me think (for I never saw it) that the fish does not exert any *muscular* strength at all when drawing its prey into its mouth (which, however, it must do, in order to expand its inside so as to make the water rush in). It occurred to me that this wonderful creature may have another power besides that of striking its prey dead by lightning, viz., that of drawing it to its mouth by electric attraction; and it appears to me not at all improbable that it should have this power, because I believe we have only to suppose that it should put itself in the opposite state of electricity to that in which it has put its prey, and then they will attract each other. Or, without supposing its prey to retain any of the electricity it has received, we may suppose the gymnotus to make itself again positive, and then its prey will become negative by induction. And we must remember that a very little power will be sufficient—a fish being very light in water, and therefore as easily moved as the light bodies which are moved by electric attraction in air. It seems to me that this would be ascertained by touching the prey with one end of a wire and the head of the gymnatus with the other end, just when the latter is approaching the former, such wire (coming up out of the water) to have an electroscope applied to it. This instrument would show whether the two are in different states at that particular time, and if they are, they *must* attract each other. It would, I think, be exceedingly interesting to find that this wonderful creature makes a double use of its electrical apparatus. Perhaps some of your scientific correspondents have it in their power to make the experiment.

I am, Sir, yours, &c.,
IGNORAMUS ELECTRICUS.

LONG AND SHORT HINGES FOR SLUICE GATES.

Sir,—Important as is the easy discharge of water through sluice-gates, the certainty and efficiency of their closing is of greater importance. On this point I have always understood that the long-

hinged character of the opening is superior to the short, and that difficulties which have occurred to the latter have been overcome by a change to the former. Referring to the discharge of water on the commencement of the falling tide, as of the greater importance in comparison, and trusting to the "*practical deductions from the investigations*" of Mr. Smith, I am of opinion, that the average opening would prove a more correct measure of the discharge of water than the extent of opening at the lower edge.

Taking the radius of the short-hinged sluice-gate at its depth of about 5 feet, the actual opening of the lower edge would be about 5 inches, diminishing to 0 at the upper. But as the angle of $3^{\circ} \cdot 42$ would produce a 10-inch opening of the long-hinged sluice-gate of 10 feet arms, as shown, I conclude the 5 feet has been referred to. Hence, 3·42 would diminish to two-thirds of that opening at the upper edge. Consequently we should have for the first two figures of the scale given, the following corrections of the proportionate area for the discharge of water:

Average Opening.

$$\frac{5+0}{2} = \ldots\ldots\ldots\ldots \; 2 \cdot 5$$

$$\frac{3 \cdot 42 + \overline{3 \cdot 42 \times \frac{2}{3}}}{2} \ldots\ldots\ldots \; 2 \cdot 75$$

$$\frac{15+0}{2} \ldots\ldots\ldots\ldots \; 7 \cdot 5$$

$$\frac{113 + \overline{113 \times \frac{2}{3}}}{2} \ldots\ldots\ldots \; 9 \cdot 42$$

I should be obliged to Mr. Smith for a statement of the other disadvantages of the long-hinged sluice-gate which he has alluded to, or for any further remarks on my deductions from his results. The question involved is one of some importance in cases where the value of land depends on the rapid discharge of water on a falling tide, through sluice-gates hung on hinges attached to their upper edge.

I am, Sir, yours, &c.,

S. S.

August 8, 1848.

NEW MODE OF SHEEP WASHING.

Dr. Alban, of Plauen, in the Duchy of Mecklenburg Schwerin, whose work on the High-Pressure Steam-Engine and new Steam-boiler has recently been noticed in the pages of this journal, is stated in the *Moniteur Industriel* to have invented a new fire-engine pump, which has been applied by a Mr. Wülknitz, of Hoppenrade, to the washing and cleansing of wool while yet upon the backs of sheep. This pump, which may be worked by hand or horse-power, is of considerable force, and throws by means of four pipes, furnished with the same number of jets, four streams of water upon the wool on the backs of as many sheep secured in open pens. The animals appear to experience pleasure rather than inconvenience from the washing. This method of cleansing the wool, which may be termed the true hydropathic system, is stated to produce a degree of whiteness, suppleness, and fineness in the material, never before attained by any other mode of treatment. It moreover gives increased energy to the organic system of the animal, and favours the fresh growth of the wool. As a further proof of the advantages of this system, it is mentioned that Mr. Wülknitz has obtained an increase of price for his wool in every market since he has adopted it.

WATSON AND CART'S PATENT IMPROVEMENTS IN THE MANUFACTURE OF GAS.

[Patent dated August 14, 1848. Patentees, John Watson, Merchant, and Edward Cart, Gent., of Hull. Specification enrolled August 14, 1848.]

The object of the present invention is to combine the ordinary hot-air stove with a gas-producing apparatus, so as that the supply of material, from which gas is evolved, to the retort, shall be regulated by the quantity of gas already produced and contained in the gasometer. This is effected by placing the retort in the stove, and causing the jointed pipe which conveys the liquid from which gas is to be evolved, into the retort to pass close to the gasometer. The portion of the pipe near the gasometer is fitted with a cock, which is connected by rods with the top of the gasometer in such manner that it shall close gradually as the gasometer rises until it has reached its limit, when the supply of liquid will be entirely cut off from the retort, and, on the other hand, that as the gasometer falls the cock shall be turned, and the retort supplied.

THORNHILL'S RAZOR BLADE.

[Registered under the Act for the Protection of Articles of Utility. Walter Thornhill, of 144, New Bond-street, and 42, Cornhill, London, Proprietor.]

Fig. 1.

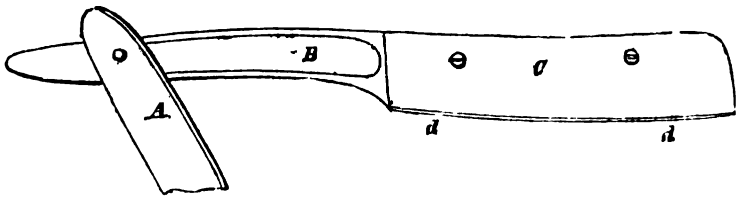


Fig. 2.

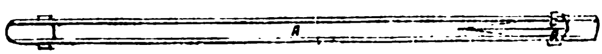


Fig. 3.

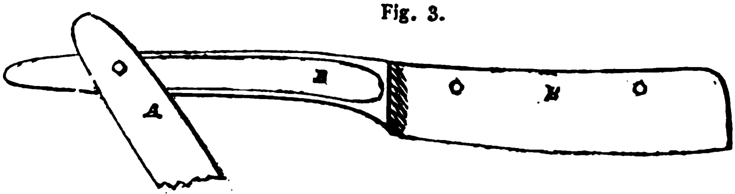


Fig. 4.

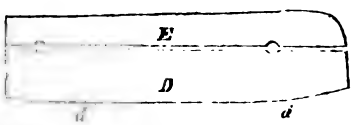


Fig. 5.

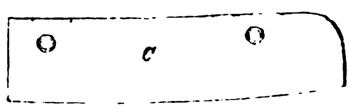


Fig. 6.

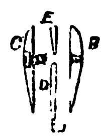


Fig. 1 is a side view of this razor, with the blade opened a little way from the handle. Fig. 2 a back view of fig. 1. Fig. 3 a similar view to fig. 1, with the parts C, D, E, afterwards referred, to removed. Fig. 4 a side view of the parts DE. Fig. 5 a side view of the part C. Fig. 6 a transverse section of the parts B, C, D, E.

A is the handle; B and C portions of the blade; and D a thin piece of steel or other suitable material inserted between them, the edge, *d*, of which forms the cutting edge of the blade. E is another thin piece for filling out the space between the upper part of the pieces B and C, when secured together by screws, as shown with the piece D between them. When necessary to sharpen the razor, the piece D is to be removed, and its edge, *d*, "set" upon a hone or other stone.

The screws, and the shape of the several other pieces of which the blade is composed, are claimed as constituting an entirely new design.

SEA WALLS—SHOULD THEY BE SLOPING OR VERTICAL?

Sir,—In my last communication upon the subject of sloping breakwaters (*ante* page 155) I endeavoured to explain my views upon some of the points put forward in the Protest of Sir Howard Douglas (vol. xlviii., p. 564), Sir John Rennie's account of the Plymouth Breakwater (vol. xlviii., p. 422), and other valuable papers upon this subject recently given in your Journal, and which, in reading, an engineer must feel, demand his most careful consideration. There remain, however, other opinions advanced in the documents referred to, which are indebted perhaps more to the exalted positions of the individuals who enunciated them, than to any other circumstance; but as they have been used as arguments in favour of the long sea slope, they deserve to be noticed as part of that evidence upon which the exclusive efficiency of that peculiar formation is maintained.

In article 5 of the Protest, Mr. Walker is made to say, "It is evident, that if the materials are deposited at an inclination, any portion being displaced *is only carried down elsewhere.*" Now, this is by no means *evident*, and must always depend upon the pitch of the slope and other variable circumstances; it is besides directly the reverse of what is stated by Sir John Rennie to have occurred at Plymouth Breakwater; for there the materials were not "carried *down* elsewhere," but *upwards* quite over the top of the work and deposited at the rear slope. Mr. Walker continues, "Although strictly speaking, it (the material) may not be wanted, it must nevertheless assist in consolidating the mass, and the *vacant spaces can easily be filled up.*" Now, it cannot be irrelevant to inquire how long this "filling up of the vacant spaces" is likely to continue, or is it ever to have an end? Is not this admitted liability in a rough sea slope to be continually breached and washed away in detail, a strong corroboration of what I endeavoured to show in a former paper, that the long rough slope carries in itself the seeds of its own destruction.

In the same article of the Protest, Mr. Palmer is made to say, that "the idea of an upright face was entirely of a speculative character, and was *contrary to the laws of nature*, which should be the engineer's chief guide." Now, even admitting the speculative character of the thing, are not the junior members of the profession entitled, under the circumstances of this statement, respectfully to call upon Mr. Palmer to explain how and in what particulars the idea of an upright sea face is "*contrary to the laws of nature.*" They will, no doubt, listen with respectful attention while Mr. Palmer, or any competent individual upon his part, expounds to them the scientific grounds for this violation of nature; but let us have no more appeals to the "strong opinions" and "practical experience" of "eminent men," which, however valuable in their own way, can never be taken to supply the place of philosophical reasoning.

I come now to the opinion of Sir John M'Neill, who, "in support of his views adduced the long slopes of sand, at an inclination of 10 to 1, thatched with straw, which resist the waves of the ocean on the coast of Holland." The fact that those long slopes of sand are capable of receiving upon their surface the most violent action of the waves of the sea, and at the same time, preserving undisturbed their uniformity of slope, is unquestionable; although for my own part I do not know why we should be referred to Holland for an example, while our own sea coasts abound with innumerable instances precisely in point. To my own knowledge, several satisfactory examples of this effect may be witnessed along the western coasts of Ireland, in the counties of Kerry, Clare, and Galway, where with a rise of 18 feet tide, the wildest Atlantic waves may be seen to expend their violence upon slopes varying from 1 in 6 to 1 in 20, composed of the finest sand; and yet within the memory of any living man, those slopes have undergone no sensible change.

But the attentive observer will not fail to notice close by, a rocky broken beach, subject to the same violent action; and there he will witness rocks of considerable weight the very sport of the element—now upheaved to the surface of the wave—then carried back by the receding water into the black deep—again met by the coming surge, and again dashed to the surface; evidently the plaything of that force which hard bye lashes out its fury upon the flat sandy slope,

and with the utmost impunity to the latter.

And now, let me ask, do these facts furnish an argument in favour of a long *rough* sea slope? Where are the data to guide the mind through the process of reasoning from the one slope to the other? I confess I cannot find sufficient; and with the greatest respect for the opinions already expressed, I do believe the validity of the argument doubtful. If a stone, three tons weight, be laid upon a hard plane of the same inclination as the sandy slope, and subjected to the same action, it will inevitably be carried away. What then preserves the slope of sand? In my opinion, *the minuteness and relative weight of its own particles.*

That the waves of the sea may develope their force, it is essential that they strike an obstacle of sufficient magnitude for that purpose; and the particles of sand presenting no such requisite dimensions—possessing, besides, considerable specific gravity, and capable by their minuteness of lying closely together under the high pressure of the water—these particles completely *elude* the action of the force, while the body of larger dimensions suffers its whole violence. It is thus that rocks of enormous weight may be shifted by the action of the sea, while sandy slopes remain unchanged; and it appears therefore *too much* to assume, that because slopes of sand remain permanent under the most violent gales, slopes composed of large blocks of stone roughly arranged at any given inclination and subject to a totally different action, should necessarily be the best possible form of construction for the face of a breakwater.

And now, Sir, permit me to conclude this paper by a word or two upon the communication of your distinguished correspondent, Mr. Dredge, given at p. 77 (*ante*). It is a mistake to suppose that all the arguments in favour of an upright face proceed upon the assumption that the motion of the sea during a tempest is wholly vertical; and no practical man ought to discuss the subject upon such supposition. "The stability of a wall," says Mr. Dredge, "by which I mean its resistance *en masse* to an overthrowing force, is compounded of its weight and breadth. It is evident, that a wall with a sea slope possesses these qualities in the highest degree. A wall with a vertical face must be composed of hewn stone, *and depends for its strength upon the bond:* if therefore, the stone composing the wall be once shaken in its bed, nothing can restore the stability of the mass." Now I beg to object in the most decided terms to this vague and pointless matter. Were Mr. Dredge reasoning upon the stability of the retaining wall of a railway to resist the application of an "*overthrowing force*" it might be conceivable; but I submit that it is incomprehensible with reference to a work of the magnitude of that under consideration. Again: in the paragraph I have quoted, *weight* and *breadth* are fairly conceded to the sea slope; but the vertical wall *must depend for its strength upon the bond!* It will indeed be most interesting to your readers to be made aware of the process by which Mr. Dredge abstracts from the upright wall, the common properties of *weight* and *breadth.*

Very truly yours,

T. SMITH.

Bridgetown, Wexford, August 7, 1848.

TOTTIE'S PATENT IMPROVEMENTS IN DISTILLATION.

[Patent dated February 14, 1848. Patentee, William Tottie, London, merchant. Invention communicated from abroad. Specification enrolled August 14, 1848.]

The invention which forms the subject of this patent, consists in causing the alcoholic vapour to pass through a series of layers of vegetable or animal charcoal, or other purifying substance, superposed one above another, and kept cool, or regulated to a certain temperature by means of water, which is caused to circulate around each layer.

The mode of carrying the invention into effect consists in the employment of a suitable vessel placed on the still-head, or in any other convenient position. Inside the vessel are arranged a series of perforated plates one above another, on which are placed the layers of charcoal or other purifying matters. Over each layer is suspended a cover, but without touching the charcoal, and made with holes to allow of the passage of the alcoholic vapour through up to the next layer. Around each layer is a channel, through which water circulates, and which is furnished with inflow and outflow pipes, and means of regulating the supply; in the top of the vessel is a sponge, through

which the alcoholic vapour finally passes. The degree of temperature of the layers of charcoal should be so regulated as that the alcoholic vapour shall leave the oil with which it is combined among the charcoal, and yet not impede the progress of the operation.

BLACK'S PATENT IMPROVEMENTS IN EVAPORATION.

[Patent dated February 14, 1848. Patentee, Horatio Black, of Nottingham, Lacemaker. Specification enrolled August 14, 1848.]

The present improvements in evaporation consist in causing the water to be supplied to steam or other boilers, to pass previously through the bars of the furnace which are connected together and made hollow for that purpose, and are composed of brass, copper, or other suitable metal. The water is made to enter by means of a force pump the centre of the set of fire bars, and after dividing into two streams, which circulate through the series, it passes out at either end into the boiler at a very high temperature.

IMPROVEMENT IN FURNACE BARS.

Among the latest patents taken out in America is one for an improvement in furnace bars by Mr. John H. Fellows, which he thus describes:—"The nature of my invention consists in an improved furnace bar as follows, viz., first, the common bar is generally made flat on the surface, but the present invention has two longitudinal grooves, and a raised centre ridge between them. The grooves fill with ashes from the fire of either coals or wood, as the case may be, which being a nonconductor of heat, keeps the bar from melting, while the raised centre ridge must always keep the same cool. Second, the raised centre ridge always prevents the possibility of drawing the ashes out from the grooves in the bar, when clearing the fire with the poker, which is requisite to keep the space between the bars from filling up with clinkers, and thereby stopping the draught; hence, the ashes always remaining in the grooves, protected by the centre ridge, keep the middle of the bar cool. It cannot therefore warp or get out of its place like the old bars. Third, in putting out the fires of either steam-boat or land furnaces, which is desirable when the engine stops, to save fuel, and the time of the hands—bars frequently break down as soon as cold water is thrown on the fire—not so with the present invention; cold water thrown on them makes the bed of ashes firmer in the grooves, and the bars are not injured by being suddenly cooled like the common ones. Fourth, the bars now in general use are made double, so that when hot, should one side give way the other must follow. This is avoided by the present invention being a single bar, which also gives a further advantage, as they can be placed at any given distance from each other, so that by widening the space, give an additional draught, which is desirable, and more particularly with low furnaces."

THE EARL OF DUNDONALD'S PATENT IMPROVEMENTS IN MARINE STEAM BOILERS.

[Patent dated February 11, 1848. Patentee the Right Honourable Thomas Earl of Dundonald, Vice Admiral of the White Squadron of Her Majesty's Fleet. Knight, Grand Cross of the Most Honourable Order of the Bath. Specification enrolled August 11, 1848.]

The present invention is stated to consist chiefly of certain improvements in a marine steam-boiler, which was the subject of a previous patent granted to the Earl of Dundonald, on the "—— ——." The date is left blank (a piece of great carelessness), but we believe the patent alluded to is one of the 5th Nov. 1835. Of the present improvements however, which are five in number, there are two which have no relation at all to boilers of any sort.

Firstly, To obtain a more perfect ignition of the gaseous products evolved from the furnace, the Earl constructs an aperture in the back of each ash-pit, whence a current of air is led up the back of the furnace (and thereby heated) into the upper part, where it mingles with the said products and promotes their combustion.

Secondly, To dispense with the steam chest placed above the boiler, where it is exposed to injury from shot, Lord Dundonald proposes to substitute a steam reservoir to be placed below the water-line of the boiler. This reservoir is to envelope the funnel, in order that the heat of the latter may be imparted to the steam contained in the former, which will consequently be worked in a drier state.

Thirdly, To prevent priming, he places horizontally in the upper part of the boiler a plate of iron or other metal, one end of which is bent vertically, and terminates in the water. The object of this plate is to prevent the too rapid ebullition of the water, and to intercept and

retain the spray carried upwards with the steam and to conduct it into the boiler To effect this object completely, the steam is caused to pass into what the patentee terms, a "Centrifugal Separator," against the surfaces of which, the spray, which may still be retained by the steam, is caused to impinge by its rectilineal motion, and is afterwards conducted by channels or other suitable means back into the boiler, while the steam passes into the reservoir in a comparatively dry state.

Fourthly, To dispense with the main-shaft or other inconvenient gear hitherto employed to connect the engine with any submerged propeller, Lord Dundonald would place in the stern of the vessel the rotary engine enveloped in the steam reservoir, and conduct the steam from the boiler to the said reservoir through a tubing composed of any substance which is a bad conductor of heat. An air and water-tight tank, filled with water, is interposed between the reservoir and the stern-post of the vessel, through which the short main shaft passes, which is thus kept cool, and leakage from stuffing-boxes prevented.

Fifthly, To prevent accidents to seamen and engineers employed in boats fitted with steam-engines, the Earl proposes to place the rotary engine inside the steam reservoir, which is close to the boiler and the centrifugal separator and other apparatus, in enclosed and raised portions, of the boiler around the funnel.

CHANCE'S IMPROVEMENTS IN FURNACES AND THE MANUFACTURE OF GLASS.

[Patent dated February 14, 1848. Patentees, James Timmons Chance and Edward Chance, Birmingham. Specification enrolled August 14, 1848.]

In reverberatory furnaces, as at present built, the flame and heat after being reverberated by the arch above is allowed to escape into the chimney. The Messrs. Chance now propose to cause the heat after it has being reverberated to pass over the back of the reverberatory arch by building a second arch above it, after which the heat, flame, and smoke are to be allowed to pass into the chimney. A second branch of their specification has relation to a peculiar description of tongs for drawing the plates of glass into annealing furnaces, formerly patented by them. Instead of *pushing* them in, as has hitherto been customary, whereby a loss was sustained by turning down a portion of the plate and allowing it to cool, they now make the tongs of a long rod wedge-shaped at one end, and carrying two vertical supports, between which turns another rod parallel to the first, and furnished at one end with a handle, and at the other with a grip of wood, so that when the workman has introduced the wedge portion of the lower rod underneath the plate of glass, he turns the handle of the upper rod, and brings the grip down on the top surface of the plate, which is thus held fast.

DEANE, DRAY, AND DEANE'S CESSPOOL CLEANSER.

Sir,—From the editorial note appended to my communication, at page 161 of your last Number, it appears I have not been sufficiently explicit in my remarks upon the above machine, the arrangement of which I described as being "as bad as could possibly be" for the purpose proposed.

My objections went, firstly, to the employment of an AIR-PUMP, which, if sufficiently well made, and of suitable dimensions, would be very expensive and difficult to keep in order. Secondly, to its SITUATION on the top of the vehicle, thereby adding from ten to fifteen feet perpendicular, and from fifteen to forty feet horizontal to the atmospheric lift—enough, in many cases, to prevent its operation.

Thirdly, I objected to the *excessive agitation* of the offensive matter, and to the exposure of an *extended surface* to the exhaustion of the air-pump.

"The improvement of raising by the pressure of the atmosphere acting against a vacuum, matters which would otherwise have to be raised by scoop and bucket," did not originate with, nor is it peculiar to Messrs. Deane, Dray, and Deane. A common atmospheric *forcing-pump* is employed for emptying cesspools into the sewers, and a similar machine might be employed for filling air-tight carts *under pressure*, thereby limiting the escape of effluvia to the smallest possible quantity. The pump being placed in close proximity to the cesspool to be emptied, would deliver its contents into a cart, at almost any distance, with certainty. The matter might also be

raised with a smaller quantity of diluting fluid than when it had to be forced by atmospheric pressure alone, through a great length of feed-pipe, and to a considerable elevation. Great lengths of (necessarily distended) feed-pipe would be exceedingly inconvenient for handling, stowage, and carriage; whereas, delivering hose, in coils, is exceedingly handy and portable.

Messrs. Deane and Co. have extensively advertised and exhibited their (miscalled "*patent*") tank-cleanser; but a practical application of it, in its present form, would soon show the "force of the objections" I have urged against it.

It is pretty evident to me that, from the extent to which it is necessary to dilute the night-soil, in order to its being raised (even under the most favourable arrangement) by atmospheric pressure, *cartage* is altogether out of the question.

I am, Sir, yours, &c.,
W. BADDELEY.

Throwleigh, Devon,
Aug. 15, 1848.

[We are still unable to concur in the justice of Mr. Baddeley's censures of this apparatus; and beg to refer to the following letter from another correspondent for some countervailing observations on the subject. ED. M. M.]

DEANE, DRAY, AND DEANE'S CESSPOOL CLEANSER.

Sir,—In the last Number of your Magazine, there was what appears to me to be a most unjustifiable attack upon the Royal Agricultural Society in reference to Messrs. Deane, Dray, and Deane's cesspool cleanser; your editorial note upon that article was certainly very just and called for. Whether the writer of that article is an agriculturist or has ever cultivated an acre of ground for the public feeding, is a question I do not ask, for the answer on that point is pretty well known to every fireman in London. Certainly those gentlemen of the Agricultural Society who have been their whole lives engaged on, and might also be said to have their whole capital embarked in agricultural occupations, should know what best suited their own purpose, and what they should award prizes for. The very fact of such gentlemen, and practical agriculturists, awarding a prize to the cesspool cleanser and manure cart, says more for it, at least as an agricultural implement, than all the carping and croaking of the writer of the article above alluded to can say against it. It was not merely a model or a drawing which was shown at the exhibition, but the real thing itself, of a working size and in working condition, and also being worked, so that the judges were not hoodwinked in the matter. But let us come to the facts. The cesspool cleanser has been employed in emptying thousands of cesspools and water-closets. And who should know better than the contractors what has best answered *their purpose* of all the things they have to choose from for cleaning out such receptacles of semifluid matters? If the great proportion of London contractors have not yet adopted it, it is no doubt because they have not been particularly solicited; from the great difficulty at first encountered in getting the proper flexible hose for this purpose, a difficulty which is now surmounted by the adoption of gutta percha tubing. The air-pump works with the greatest ease, and requires only a little water thrown upon it at the commencement, by which it is kept in excellent working condition, as there is no valve in the passage through which the matters to be pumped up pass. For farmers' liquid manure carts it answers admirably, straw and chaff forming no obstruction, but passing up along with the more fluid portions. For cesspool and water-closet cleaning, of course there are several considerations requiring to be attended to, not so strictly necessary in agricultural purposes, namely, the bringing up the stuff into the cart with the least possible production of smell and dirt. As to bringing up the stuff, little needs to be said on that subject, as the thing can be easily seen in operation; but for the information of those who cannot spare time for that purpose, it may be as well to state that while the matters require to be in a semifluid, and not in a thick state, yet at the same time, where the great proportion of the matter is in the proper condition, should a dead cat or a half brick (things not unfrequently found in such places) come in the way, up it goes into the cart along with the other substances, provided that the hose be of a sufficient size for their going through it. Messrs. Deane, Dray, and Deane never put forward their cart as an article by which cesspools could be cleaned out without any smell (with Ellerman's deodorizing fluid certainly it would); but now the matter has been questioned, it may be stated that experience has proved that it produces far less than the scoop and shovel process. If they had proposed to expel the semifluid matters by means of compressed air, then there might have been some grounds for the fears expressed by your correspondent, when he says, "It is just the reverse of what sane science would suggest."

I am, Sir, yours, &c.,
S. B. MILNE, Engineer.

THE BRITISH ASSOCIATION AT SWANSEA.

The annual meeting of this Association has been held this year at Swansea. From the notices of the proceedings which have appeared in the newspapers, we are not led to anticipate much gain to mechanical science from the contributions of its members on the present occasion. We make the following extracts from the Report of the *Morning Chronicle :*

New Element in Mechanics.

"Mr. Roberts exhibited and explained the construction of a mechanical contrivance, by which in a very simple manner movements may be effected, for which more complicated mechanism is frequently employed. The model consisted of a steel shaft, on which were loosely fitted two brass discs, having each a boss to keep it steady. One of the discs had eleven teeth (rounded at top and bottom) in its circumference, and was placed on the body of the shaft; the other disc (which was somewhat larger), was on the eccentric position of the shaft, with its face to that of the toothed disc; the plain disc had four studs riveted into it at equal distances from each other, and at such distance from its centre as to admit of their being brought successively by the revolution of the eccentric to the bottom of the hollows in the toothed disc. The following movements may be effected by this model, namely: If the shaft be held stationary and the disc be made to revolve upon it, one of the discs will make twelve revolutions whilst the other makes only eleven. Again; if the toothed disc be held whilst the shaft be made to revolve twelve times, the plain disc will revolve in the same direction one revolution only, and if the plain disc be held, the toothed disc will perform one revolution in the contrary direction for eleven revolutions of the shaft. It will be evident that almost any other number of revolutions may be produced by employing a smaller number of studs, not fewer than three, which will not divide the number of teeth in the disc. The idea of this novel element of mechanism was, it is stated, suggested to Mr. Roberts by a dial movement in an American clock.

"The discussion of this new element of mechanism excited very great interest, and it was stated in the room that it was likely to lead to very important results."

Employment of Electro-Magnetism as a Motive Power.

An interesting excursion was made to Penllergare, the mansion of J. D. Llewelyn, Esq., about five miles from Swansea. The favourable weather made the drive to and fro, and the promenade in the grounds and on the shores of the lake truly delightful. The boat, which was impelled by the electrical current, was the principal object of attraction. It was not constructed for the purpose, but was the boat ordinarily used on the lake for pleasure, capable of conveying about six persons. In the bow of the boat a galvanic battery was placed, which, having connecting wires, with a small retort filled with mercury at the stern, enabled the professor, who steered the boat, to connect or disconnect the circuit of the fluid as he pleased. Near the centre was a solid cylinder, constructed of wood, but bound with copper, which revolved on its axis, and from which electric sparks were freely emitted. This cylinder was in a state of continuous revolution, and with the cylinder a rod was connected, which caused the fans placed at the stern of the boat to revolve. The application of electric locomotive power is doubtless a question of great interest, and it is chiefly a question of expense and speed combined. The boat is ordinarily paddled from the stern, with one oar; its progress is slow, as compared with that of the Thames wherries: the battery required to work it is a powerful one, and yet the progress which it made in its excursion round the lake was not swifter than that which it would make with ordinary paddling. At present it is a scientific toy; but it clearly establishes the principle that electricity can be converted into a motive power for the propulsion of vessels, thereby saving the space at present occupied by the engines and fuel; and, as the power can be indefinitely increased, (?) so as to meet the required speed, the sole question is one of expense.

BARON VON RATHEN'S COMPRESSED AIR-ENGINE.

Sir,—It is the first time that I avail myself to address you in reference to my enterprise, of introducing a new system of locomotion on railroads, by the use of compressed air carried along upon the carriage; for which, on a large scale, an experimental carriage has been constructed in the workshops of the College for Civil Engineers, of which you have been kind enough to insert a great number of notices, and extensive calculations on the merits of my system, in your most valuable Journal.

The object of thus addressing you myself, is principally to correct an error of your reporter, which might be very prejudicial to my system. In the notice in your last Number it is stated, that in our first trial (on the 9th August) on the Wandsworth Road, we had travelled at the rate of about 8 miles; and, that by an attempt to in-

crease our speed to 10 or 12 miles, we had broken or exploded some tubes of our air-reservoir on the road.

I am afraid that such an incorrect report would injure my invention. The impossibility of an explosion or bursting of the air-reservoir by the inclosed compressed air *during a journey*, is one of the qualities of safety on which I have, and do still prize my system as superior to the steam boiler. And as we made a second trial last Friday, in presence of some hundreds of spectators, on the same road, from Putney to Wandsworth, starting up hill, with about twenty persons upon the carriage, (by itself about three tons weight,) with a very great speed, probably on an average of about 12 or 13 miles, without having, either on the first or on the second trial, had the least possible accident or injury to the air-reservoir or machinery, I must beg you to correct this dangerous error. The fact is, that about fourteen days ago, on the 28th July, during my absence, the compressing apparatus was set to work for some trials, and continued to charge the reservoir to an undue extent of pressure, by the probable overlooking of the superintendent. This overcharging continued till about two-thirds of the tubes forming the air-reservoir exploded—were destroyed, or at least made useless for the present. This happened in the workshop of the College, where the compressive pressures were still kept in work during the explosion, and only stopped after the mischief was done.

Considering, then, that the remaining third part of the reservoir had been only charged by way of a late caution, to a very low degree—in such manner, that hardly one-quarter part of the power was contained therein as was first intended—it follows, that with the whole reservoir, and the full extent of the regular pressure, we could have gone twelve times as far.

But distance being of no great consequence, it appears to me that the object for which this experimental carriage has been constructed has been fully attained, viz.,

1. To show the practicability of compressing large quantities of air to a very high extent (say of 700 lbs. to 800 lbs. per square inch), and to retain it in air-tight vessels or reservoirs of an adequate strength for any useful time, by the application of my system, without any considerable loss of power or straining of machinery."

2. To show that air at any extent of pressure (say 50 atmospheres) may, by means of my expanding apparatus and moderator, be brought down to an uniform working power of four or five atmospheres, without great loss of power by refrigeration.

Safety and convenience are visible to every one. But the great economy to be gained over steam locomotion (which I estimate at about 75 per cent., when all my inventions in generating steam and working compressed air are applied) can only be proved when fairly brought out in traffic—like the atmospheric system on the Croydon line.

I am willing to prove, by calculation and argument, this immense saving in expense, when my system is fairly brought out on a large scale (like the power-looms, it pays not, in detail, for one carriage or so). And whatever I may have still further to suffer, and obstacles to overcome, I shall fight a struggle so long as I have breath, to bring this great boon fairly for the public use; and hope you will, from public views, continue to lend me your valuable assistance therein.

I am, Sir, yours, &c.,

BARON VON RATHEN.

Putney, August 15, 1848.

MESSRS. HARVEY AND WEST'S HYDRAULIC VALVE.

Sir,—We observe in your publication of June 3 last, a description of an hydraulic valve by Mr. John Pool, jun., of Hayle; we beg leave to refer him to the valve now in very general use, and known as "Harvey and West's Patent," as every advantage mentioned by him is there embraced, and has been acted on in almost the whole of the waterwork establishments in London, as well as a variety of other places. Should Mr. P. be still reluctant to recognise the virtues of our patent, we would refer him to his neighbours, Messrs. Harvey and Co., who have generally some in make.

We are, Sir, yours, &c.,

HARVEY AND WEST.

Hayle Foundry, Cornwall,
August 3, 1848.

TEMPERATURE OF THE ARCTIC OCEAN.

The proceedings of the Academy of Sciences of Paris, for March 13, 1848, contain the following account of a memoir, by M. Ch. Martins, on the temperatures of the Arctic Ocean, at the surface, at great depths, and in the vicinity of the Glaciers of Spitzbergen. The extract is by the author :—

This memoir rests upon 305 observations of temperature, made by MM. Bravais, Pottier, and myself, in the four voyages of *La Recherche*, between Hammerfest, in Lapland, (latitude 70° 40′ North,) and Spitzbergen as far as 79° 34′ N., as well as in the neighbourhood of the glaciers of that island, during the summers of 1838 and

1839. The principal results which follow from these observations, are the following:

I.—*Temperature of the Surface of the Sea.*

1. In the middle of summer, the temperature of the Artic Sea, is sensibly equal to that of the air.

2. Nevertheless, as a mean, that of the sea is a little higher, owing to the influence of the Gulf stream, whose extremities are lost upon the western shores of Spitzbergen.

3. The immense glaciers of Spitzbergen, which plunge and crumble into the sea, exercise a very sensible cooling influence upon its surface. The coasts of Norway, where glaciers do not descend to the level of the sea, tend rather to raise its temperature.

II.—*Thermometric Soundings at Great Depths.*

These temperatures are always the mean of the very concordant indications of several Walferdin thermometers, sent simultaneously to the bottom of the sea, and preserved from pressure by a sealed glass tube. The scales which were engraved upon the stems were arbitrary, and nine divisions correspond to one degree centigrade. The following are the most important conclusions from these experiments:

1. Between 70° 40′ and 79° 33′ North latitude, and from 7° to 21° 15′ longitude, east of Paris, the temperatures of the Arctic ocean decrease with the depths, during the months of July and August.

2. These temperatures are always above 0°, (32° Fah., at least to a depth of 870 metres, 953 yards,) the greatest depth attained in these experiments.

3. Comparing the temperature at the surface with that at the bottom and those intermediate, it appears that the decrease is uniform, at the mean rate of 0·625° per 100 metres, (0·343° Fah. per 100 feet *nearly*.)

4. The temperature of a liquid layer is more constant in proportion as its depth is greater.

III.—*Temperature of the Sea in the Neighbourhood of the Glaciers of Spitzbergen.*

1. In the months of July and August, the temperature of the surface, although very near the freezing point, is always above 0°. (32 Fah.)

2. From the surface to the depth of 70 metres, (230 feet,) the temperature sometimes increases, sometimes decreases.

3. From the depth of 70 metres, the temperature always decreases with the depth.

4. The decrease of temperature from the surface to the bottom is not uniform; but accelerates with the depth.

5. Between the surface and a depth of 70 metres, it is never below 0°, (32° Fah.)

6. Below the depth of 70 metres, the temperature of the water is below 0.

7. As a mean, the temperature of this water is, 1·75°, (28·85° Fah.,) and consequently, above that of the maximum density and freezing point of sea water, as determined by M. Despretz.

8. These facts are easily explained, if we remember that the point of maximum density and that of freezing, of salt water, are several degrees below 0, and if we take into consideration the complex influences, intermitting, and of variable intensity, exercised by the freezing of the surfaces during winter, the glaciers, the floating ice, the tides and currents.

THE MARINE GLUE.

We extract the following interesting discussion on the merits of this invention from the House of Commons Debates on the Navy Estimates for the year:

August 11.

Captain PECHELL complained of inattention on the part of the Board of Admiralty to the advantages of employing the marine glue, and the injustice with which the experiments had been made, which did not give the article a fair trial, or afford a sure test of its qualities. It had been applied to the deck of the *Thetis*, by caulkers, where the seams had been filled up with dirt. Wherever the article had been fairly and properly used, it had been successful; but to allow it to be applied where the seams were filled with rubbish and dirt, was not only not giving it a fair trial, but was calculated to injure and deteriorate its character. He wished to have a return of the comparative expense of common caulking and the application of marine glue.

Lord JOHN HAY could assure the committee that the Board of Admiralty had shown every disposition to do the utmost justice to Mr. Jeffery. Who could benefit more than the Board of Admiralty from the application of an economical material to the caulking of ships? But, before the honourable and gallant member pronounced a condemnation of the Board of Admiralty, he should have inquired what steps they had taken to test the real merits of the article. In the first place, before they gave encouragement to an invention to be employed as a substitute for another in use, it was wise for a public board to ascertain the cost of production. As the marine glue was to be substituted for pitch, the question of the difference of price was an important question. The late Board of Admiralty had ordered a certain quantity of this glue to be manufactured at Chatham, and the officer at Chatham Dockyard had reported, the 18th of August, 1843, the cost of the materials and the expense of making; and the result, as stated in his report, was, that the cost of manufacturing 12 tons of marine glue was, upon an average, £36 6s. 4d. per ton. This glue was to be substituted for pitch, and the value of a ton of pitch was £5 17s. 6d., or little more than one-seventh. Experiments had been made of the glue on board the *Penelope*, on the coast of Africa, and he freely admitted they had succeeded ("hear," from Captain Pechell); but there was a decided objection to the use of the glue below the upper deck, on account of the smell. What had the Board of Admiralty done in consequence of the successful experiment on board the *Penelope*? It was ordered by the late

board, on the 6th of June, 1846, that the marine glue should be applied to the weather decks of all new ships—the glue could not be applied in conjunction with pitch, as they would not act together, and in 60 or 70 ships the upper decks had been payed with marine glue. With respect to applying the glue to the sides and bottoms of ships, that was found not to succeed, as the glue cooled so soon. With regard to its application to the manufacture of masts, it was well known that a mast was composed of, perhaps, 12 different pieces of wood, and it became necessary to exercise great vigilance to see that all the parts were in good order; for if one spar was damaged, so much of the strength of the mast was lost. One of the *Eagle's* masts had been reported to be rotten, and she came to be repaired; the Board of Admiralty ordered it to be taken to pieces, and what was the consequence? The following report was made in respect to that matter, dated the 25th of July last:

"With reference to your minute of the 1st inst., and their lordships' order of the 30th ult., signifying their intention of testing the merits of Jeffery's glue for mastmaking, and directing us to cause the *Eagle's* mast, which was put together with this description of glue about four years ago, to be taken to pieces, and for Mr. Jeffery to be present, we beg to state that the mainmast is the one so put together, and that it has been separated under the superintendence of Mr. Jeffery, who has fully satisfied himself, and acknowledged that it cannot be disunited by the force of the wedge without destroying the material for further use in mastmaking, the adhesive qualities of the glue tearing and injuring the timber on both surfaces. It was then suggested by Mr. Jeffery that the parts might be sawed asunder, which has been done; but this operation will not insure the safety of the material for further use (if found sound), because, with all the care, the saw cannot be kept straight through the depth of the surfaces, and it was found in various places to have run hollow, and therefore to repay these parts would reduce the mast below its proper dimensions. The separating has been tedious and expensive; it has cost in labour £4 14s. 3d., and taking a mast apart (put together with paint) can be done for £1 7s. 8d. We beg to refer to our letter of the 3rd of May last, reporting on this mast, wherein we stated that not more than about one-half of the glue on the surfaces had united the parts together: but we do not allude to this as the cause of the defect, but that by being paid with glue has not prevented decay, as the cheeks, side, trees, and one half spindle are defective; the other parts are sound, but not fit to be replaced in a mast. We also beg to state that the scarph of the main yard was put together with marine glue: the yard being defective on the outside, we have separated the scarph by the force of wedges; these surfaces, as with the mast, have been destroyed. In this case, sawing could not be resorted to, because the scarph at the ends partakes of the rounding of the yard; we are therefore of opinion, as the marine glue does not appear to us to prevent decay, that it is not preferable to white paint for putting masts together, and particularly so as a mast cannot be taken apart for examination without destroying the materials for further use in mastmaking."

This report was signed by the three surveying officers and the Admiral Superintendent of the dockyard at Devonport. Now, he would ask the hon. and gallant gentleman whether he was aware of the cost of a mast in a line-of-battle ship, because, if masts were to be thrown away in this manner, the hon. and gallant gentleman must be prepared to give the Government a large supply of money for furnishing ships. No officer, he believed, would like to take the command of a ship unless his masts were examined once in four years. The first application of Mr. Jeffery was for £30,000 as a reward, and he afterwards reduced it to £15,000.*

Captain PECHELL begged to observe that he had not addressed the committee on this subject with the view of making any application for money.

Lord J. HAY then proceeded to say that there existed no indisposition on the part of the Admiralty to do Mr. Jeffery every possible justice; and when the material had been sufficiently tested, it would, no doubt, if useful, be brought into extensive consumption; and then he supposed that Mr. Jeffery would be in a position to expect a reward for his invention. He should have no difficulty in producing the return asked for.

Mr. HUME thought it fair that a reasonable time should be taken for testing the invention, but conceived that, limiting its application to the upper decks, it was a valuable discovery. By increasing the durability of the articles composing a ship, they would economize much money.

August 15.

Captain PECHELL said, he was sorry to trouble the House, but a statement had been promulgated as coming from a noble lord, (Lord John Hay), which was calculated to do a great, though he hoped only a temporary, injury to Mr. Jeffery, the inventor of the marine glue for caulking ships, and he was anxious, in justice to that gentleman, to put the matter right. He (Captain Pechell) had, upon that occasion, endeavoured to show that in every instance in which that article had been applied to the weather decks of vessels it had been completely successful, and, in consequence, Mr. Jeffery had applied it to masts. He had a report from Sheerness, which showed that, when properly applied, the glue rendered unnecessary the present practice, in the dock-yards, of pulling the masts to pieces. The noble lord had spoken of the unpleasant smell from the use of the glue between decks. That referred to the old affair of the *Victoria* and *Albert* steamer, where bilge-water got a peculiar smell from running through the tarred felt used in her, and not from the marine glue, there being none of Mr. Jeffery's glue in her at the time, the glue used being composed at the dock-yard. In vessels chartered for carrying troops no inconvenience had been felt from the use of the glue between decks; there was no disagreeable scent; and it was found much cleaner than pitch. He had a letter from Messrs. Smith, of Cornhill, to Mr. Jeffery, stating "there is no offensive smell from the marine glue in our passenger-ships;" that "it was applied to the *Ellenborough* five years ago, and to the *Tudor* two years ago, and the *Marlborough* and *Blenheim* this year, and no offensive smell whatever has been found." They added: "It had been applied to the three decks of the *Marlborough*, now in the East India Dock, which any parties are at liberty to examine." He (Captain Pechell) could not understand on what principle it was that an endeavour was made to depreciate so valuable an invention. If the application of the glue cost more money in the first instance, there would be found a vast reduction of expense eventually by using it, if it had a fair trial. A case occurred in 1846, in which a steam-tug, called the *Trinity*, caught fire in the Thames, and the whole of the interior was consumed, but the planks which were payed with the marine glue were not in the least touched by the fire; the glue held the planks together, though the boiler-deck had been forced up by the fire. He trusted the noble lord would do justice to the merits of Mr. Jeffery's invention.

Lord J. HAY said, the Board of Admiralty were anxious to do justice to Mr. Jeffery; but, at the same time, it was wise to test the merits of the article before incurring expense. He repeated that

* Either sum seems enormous for an invention which consists merely in the mixture of caoutchouc with shell lac; considering especially that Mr. Jeffery has but followed out a suggestion of the late eminent surveyor of naval works, General Bentham. See *ante*, p. 175.—ED. M. M.

orders had been given that the seams of new ships should be payed with the marine glue, with the exception of the lower decks. So late as the 23rd of May last, orders had been issued to the officers of the dockyard to pay the seams of the *Fairy's* decks with marine glue, and they had objected, in a letter to the Board of Admiralty, on account of the result of the experiment in the *Victoria* and *Albert*. He could only repeat, that the Board of Admiralty had every disposition to do justice to Mr. Jeffery.

Mr. Ward said, this gentleman had invented a glue, which might become beneficial to the public as well as to himself, and these statements were intended to bolster up his pecuniary claims upon the Government. Since the last discussion on this subject, he (Mr. Ward) had received from Mr. Jeffery a letter reiterating a claim he originally made to the Board of Admiralty for £30,000. A claim for pecuniary reward to so large an amount could be justified by the well-attested merits of the invention only. Notwithstanding, then, all that had been said, he feared that the Admiralty must give up the use of this glue until Mr. Jeffery moderated his expectations. They would give him all fair and reasonable facilities, but would not go to the length of admitting a claim so untenable as his.

NOTES AND NOTICES.

Speed of Ocean Steam-boats with English-made Engines.—Baron Seguier stated, at a late meeting of the French Society for the Encouragement of National Industry (from one of the bulletins of which we take this notice,) that he saw, when off Havre, two English steam-packets, the *Success* and the *Express*, which make the trip from Havre to Boulogne, a distance of 149 statute miles, in five hours, which is close on 30 miles an hour—a rate of speed never before attained in steam navigation, either on sea, lake, or river. Baron Seguier described these boats as being very long, shaped like pirogues, and carrying their sails arranged in a new way, so that they can take advantage of the slightest wind without losing the necessary stability of the vessel. Their engines are of 350 horses power, and built by Messrs. Maudslay, Sons, and Field, on the annular principle.

Another Step in the Progress of the Press.—The American papers make mention of a machine which has been recently invented at Springfield, Mass., for folding newspapers and other printed matter. It is to be connected with a cylinder press, so that the sheets come forth from the press folded in the required form. The inventors warrant it to fold 3,600 sheets per hour, of any size, with the greatest accuracy.

Enormous Wire Rope.—A wire rope is now in course of construction at the Works of Messrs. Newell and Co., Gateshead, which will, when completed, be of the extraordinary length of 6720 yards, and will weigh 27 tons.

Concussion Shells.—Woolwich, Aug. 5.—Lieut.-Colonel Crittenden, Lieut.-Colonel R. Hardinge, Director of the Laboratory Department, and Lieut.-Colonel J. A. Chalmer, Assist.-Director General, attended at the Practice-range, in the Plumstead-marshes, to witness experiments with a new concussion shell, the invention of a Mr. D. A. Tucker, and which, in military circles, has caused almost as much curiosity as the long range of Captain Warner, partly from the difficulty of procuring an effective concussion shell, and partly from the very high merits which the inventor laid claim to for his shells. He says it can be manufactured "to any calibre," can be fired from "cannon on the old principle," explodes by simple contact with a body, hard or soft, insures a longer range, greater certainty of range, safety in handling and transporting, so that it can be stowed on a vessel's deck during engagements; explodes equally well under water, not being dependent upon ignition, and is fearfully destructive. He also guarantees to alter all the existing shells in the service to his own principle. Six rounds only were fired from 32-pounder guns at a range of 400 yards. The four first shells burst on striking the target, the fifth a few seconds after striking the target, and the sixth appeared to be a failure. The experiments were constantly interrupted by the movements of various vessels which passed up the river within the line of fire.

A Prodigious Pair of Shears.—The mastmakers of Sheerness Dockyard have just completed a powerful shears formed of pieces of timber joined together in a similar manner as the made masts of first-rate ships of war in the Royal Navy. Some idea may be formed of the magnitude of the main support of the shears, when its dimensions are given, being 127 feet long, and 3 feet 1 inch in diameter on the average throughout its entire length. It contains 1,300 feet of solid timber, weighing 27 tons, and required 52 pieces, each cut out of large-sized trees, and joined together with Jeffery's marine glue, of which it required 5 cwt. to coat the joinings, and it has been so uniformly applied by the workmen that the superfluous quantity oozing from the joinings on the pieces of wood being pressed together with iron hoops, is calculated not to exceed ten pounds weight. The two side-shear masts are each formed of two very large trees, joined together with the same substance, and when they are put up will be of a most efficient description, and capable of shipping and unshipping the largest masts used in the Royal Navy, and moving other great weights.

Death of Mr. Richard Witty.—The Hull papers announce the death, on the 3rd inst., at the age of 76, of Mr. Witty, the acknowledged inventor of the oscillating steam-engine. He died after a protracted illness, and in circumstances, we fear, of considerable distress. A subscription was set on foot for him two or three years ago, but it never reached an amount at all commensurate with the services he had rendered to the country, or with the general estimation in which he had always been held, as a man equally distinguished for mechanical genius and moral worth.

The Screw.—The *Hants Telegraph* mentions that thirteen different forms of screw-propelling have been tested by the *Minx* steamer; the result of which was that Woodcroft's screw propelled the *Minx* at nine knots an hour, and that when at its greatest velocity the engines performed about three revolutions per minute more than with any of the other screws. The peculiarity of the Woodcroft screw is that it is made with an increasing pitch. Now, in justice to the other twelve screws, it should have been added that any diminution of pitch which can take place in one turn or half turn of a screw (none of the screws being of greater length) is so small as to not only be imperceptible to the eye, by practically of no effect whatever. The gain of "three revolutions" must have been owing to some other cause which does not appear.

"*All One.*"—The *Morning Chronicle* heads its notice of the election of "W. Edkins, Esq. M.A.," to the *Geometry* chair in Gresham College thus: "The Gresham Professorship of *Divinity*." A sly way this of rebuking a gross breach of trust. 'Tis as much as to say, that whether it be geometry or divinity, or anything else, which the fortunate gentleman has been elected to give lectures upon, is of no manner of consequence. The salary 's the thing.

Death of Mr. George Stephenson.—It is with much concern that we announce the decease of Mr. George Stephenson, the celebrated engineer. He died at his establishment in Derbyshire, on Saturday last, aged 67. Few men have obtained, or deserved, a higher reputation. He rose from the humblest life from the elasticity of his native talent overcoming the obstacles of narrow circumstances and even confined education. In his profession he was as happy and ingenious in his discoveries as generous in imparting the benefits of them to the world. In the history of railroad enterprise and movement the name of George Stephenson will live.—*Times.*

WEEKLY LIST OF NEW ENGLISH PATENTS.

Samuel George Hewitt, of Buchanan-street, Glasgow, engineer, for improvements in the construction of certain parts of railways. August 11; six months.

John Varley, of Bury, Lancashire, engineer, for certain improvements in steam-engines. August 14; six months.

James Henderson, of the Surrey Canal Dock, millwright, for improvements in machinery for cleansing and polishing rice, pearl barley, and other grain and seed. August 14; six months.

Joseph Simpson, of Manchester, civil engineer, and James Alfred Shipton, of the same place, engineer, for certain improvements in steam-engines. August 14; six months.

Edwin Thomas Truman, of No. 40, Haymarket, London, dentist, for an improved method or methods of constructing and fixing artificial teeth and gums, and of supplying deficiencies in the mouth. August 15; six months.

Thomas Warren, of Montague-terrace, Mile-end-road, Middlesex, gentleman, and Willoughby Theobald Monzani, of James-terrace, Blue Anchor-road, Bermondsey, Surrey, gentleman, for improvements in the construction of bridges, aqueducts, and roofing. August 15; six months.

Thomas de la Rue, of Bunhill-row, Middlesex, manufacturer, for improvements in producing ornamental surfaces to paper and other substances. August 15; six months.

William Galloway and John Galloway, of Knott Hill Ironworks, Hulme, Manchester, for certain improvements in steam-engines. August 17; six months.

Moses Haym Picciotto, of Finsbury-square, London, for a method or methods of purifying and discolourizing certain gums. August 17; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Aug. 9	153	Cornelia Smith	Crew, Chester	Female elastic supporting band.
11	1585	James Lamb Hancock	Coed-y-Cade, Montgomeryshire	Frame for a carpet or other bag.
14	1536	Welch, Margetson, and Co.	Cheapside	Back of a pair of braces.
,,	1537	John Whitehead	Preston	Tile machine.
15	1538	John West and John Henry Weston	Lambeth / Southwark	Moon, or globe, for gas or other lights.
16	1539	John Warner and Sons	Cripplegate	Beer engine.

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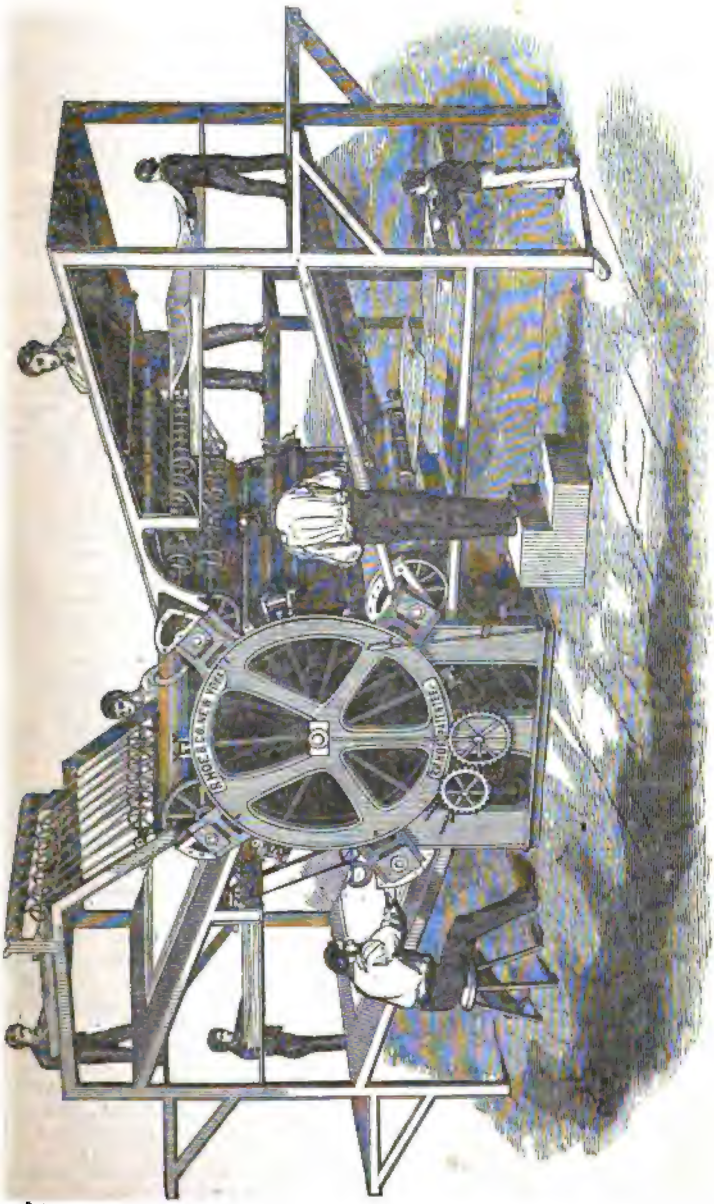
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1307.] SATURDAY, AUGUST 26, 1848. [Price 3*d*., Stamped, 4*d*.

Edited by J. C. Robertson, 166, Fleet-street.

AMERICAN FAST PRINTING PRESS.



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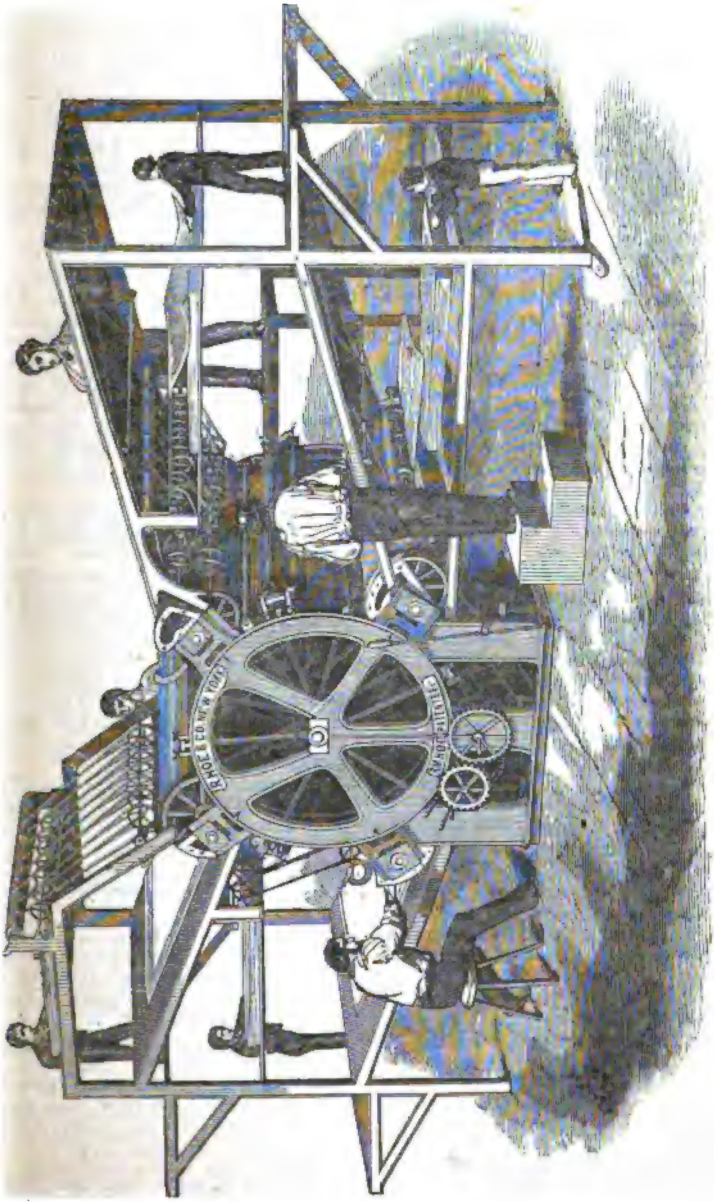


AMERICAN FAST PRINTING PRESS.

Invented by Messrs. R. Hoe and Co., of New York.

(From the *Eureka.*)

Everything connected with improving the "Art of Arts," is as much an act of general good to the whole human family as it is magnanimous in its achievement—particularly in this age, which seems to have been especially favoured in almost every conceivable way, relating to improvements in printing; that is, in that branch which is to cause a multiplication of the number of copies within a given time. We give an engraving of the latest and greatest of these many improvements; and also a description of its general features, copied, it is true, but its faithfulness is endorsed by the inventor and ourselves. We will add, however, that since that article was penned, several of these presses have gone into successful operation; they are now used in the offices of the *Sun* and *Herald*, of New York; *Ledger*, Philadelphia; and *Times*, Boston. Col. Hoe has also just returned from Europe, where he has secured patents generally, and some orders for the presses themselves; these are to be built in this city, and shipped to their destination abroad.

The following detailed description is from the *Philadelphia Ledger:*

Hoe's last Fast Press.—We have now got fairly at work, running off the immense nightly edition of the *Ledger* upon the newly-invented Cylindrical Rotary Printing Machine, which a few days since we announced to our readers as having been manufactured for the *Ledger* by the Messrs. R. Hoe and Co., patentees and printing press manufacturers, of New York. We doubt not that subscribers to the paper will be interested with a brief description of the machine, and of its invention, particularly as the principle of its operation is so entirely different from that of any printing press ever before put into successful use in this country, or in the world; that it has been with printers a disputed point, not only whether any machine could be invented by the most ingenious mechanic, capable of applying this principle to printing; but, even if there could be, whether the principle itself could be adapted to letter-press printing. We think this last great invention, of which the first and only machine illustrating it yet manufactured, is that upon which the *Ledger* is now printed, proves the truth of the hypothesis, that the principle is susceptible of being applied, and with success.

There are, of course, and by those experienced in mechanics always to be expected, more or less difficulties, delays, and vexations, necessarily incident to introducing and putting into operation any new improvement. We have found this to be the case, as many of our readers will recollect, with each of the improvements for greater speed in printing, which have been successfully introduced into use upon the *Ledger*, from time to time, in the course of its progress to its present extensive circulation.

It is probable that no art has made more rapid advances during the last fifteen or twenty years than that of printing; and to the invention and introduction of rapid machine presses, may be attributed the main reason of its great progress; for in proportion as any of the necessaries, conveniences, comforts, or luxuries of life may be cheapened in cost, so as to be brought more immediately within the reach of increased numbers, so does the public demand for an increased production of such comforts multiply; and this arises from the fact, that just in such proportion are the millions benefited.

The facilities afforded by the rapid press, without which, such newspapers as were demanded by the public were limited in their means of supply, has greatly aided, by a reduction of cost and the increased means of supply, to secure to many establishments unprecedented numbers of subscribers.

Previous to 1826, although there had been no rapid presses for newspaper work introduced in this country, yet the minds of many ingenious persons had been turned to the evident need of increased expedition for the use of the daily press.

Treadwell, of Boston, had invented an improved book press, many of which were made by Robert Hoe and Co., with which printing could be executed twice as fast as with the ordinary hand press. Still this did not answer in all respects for newspaper work.

About this time, Messrs. Dwight, Townsend, and Walker, proprietors and publishers of the *Daily Advertiser*, procured from England a double-cylinder press, of Napier's invention, and Major M. M. Noah, also, shortly afterwards, one of the same patentee's single-cylinder presses. These were then considered of most extraordinary power and capacity; indeed, the former, from its *great speed*, of about 1,800 impressions per hour, and requiring four boys to supply and receive the sheets, was looked upon as not only extremely expensive to use, but unnecessarily fast.

Messrs. R. Hoe and Co. immediately commenced building single-cylinder presses, and they at once simplified and improved them.

The first machine of the kind was made for the *Commercial Advertiser*, of New York, after which they were called upon to build others for most of the daily papers of that city; but so closely did the demand follow the increased means of supply, that it was soon found that still further expedition was necessary to supply the papers in season. Accordingly, in 1830, Messrs. Hoe and Co. turned their attention to simplifying, improving, and manufacturing the double-cylinder presses, which had but so short a time previously been considered unnecessarily fast. These, with the more popular dailies, took the place of the single-cylinder press, and answered very well up to 1838, about which time Col. R. M. Hoe, one of the firm of the Messrs. Hoe, visited Europe, and on his return turned his attention to further improvements upon the double-cylinder, with a view to still greater speed, such as was required not only by the greatly increased number of copies issued, but by the sharp competition which had sprung up between the various papers of that city, in holding back to the latest hour for news.

Col. Webb, of the *New York Courier and Inquirer*, to distance all competition, in 1838, imported, at great expense, a four-cylinder Napier printing machine from England; and, although a machinist from the manufacturer came out with the press to put it in operation, it was found not only too complicated, but that it would not answer for the thin paper used by American newspapers, and it was abandoned.

The success of the cheap cash papers about this time, which had been introduced, rendered faster printing still more necessary with them.

In 1834 or 1835, Mr. Benjamin H. Day, of New York, planned and commenced the publication of a small one cent paper, called the *Sun*. It was a novelty for a newspaper, containing a digest of the news of the day, but principally devoted to local affairs, and, being well conducted, was calculated for general circulation among the people, because the other daily papers were not only too expensive for the million, but had become, most of them, too entirely restricted to commercial matters and partisan politics. Mr. Day's paper soon acquired a large circulation, and others were soon started, among which were the *Transcript*, *Star*, *New Era*, *Herald*, &c., &c., some of which obtained numerous subscribers and an extensive advertising business. Others were also started in other commercial cities, among which were the *Public Ledger*, of Philadelphia, at the present time, we would remark, numbering its *thirty thousand* subscribers and purchasers daily.

In the year 1839 or 1840, Col. Hoe had so far improved upon the double-cylinder Napier press, with one of his own invention, a two-cylinder press also, as to be able to print with it the smaller-sized papers at a speed of from five to six thousand per hour, whilst, with the greatest speed of the Napier, with all its improvements, but about three thousand per hour could be given.

This would add another grand desideratum attained. The pair of fast presses upon which the *Ledger* has been worked for the last five or six years, are of this construction, and well have they done service, and proved the value of the invention. At the time these presses were put into use, the impression generally entertained was, that no greater rate of speed than *these* afforded, would *ever* be required. They were equally as rapid as the four-cylinder English press, and required but about half the cost in attendance.

But how little is even the most comprehensive mind capable of grasping the future. The only limit to the circulation of the *Ledger*, as of two or three other newspapers in other cities, has been, for many months, the impossibility of accomplishing the work required of them in season for delivery in the morning, even with the presses last referred to; and for two or three years past, the attention of some of the most ingenious mechanics of the country has been bent upon producing a machine that would print with still greater rapidity. Mr. Beach, the present proprietor of the *New York Sun*, to perfect an invention that, in his estimation, promised this result, spent a large sum, but it did not succeed.

It has remained for Colonel R. M. Hoe, the senior partner of the house of R. Hoe and Co., of New York, to produce for the *Ledger* an invention of the most successful and complete character, throughout entirely new in principle, and *capable of printing twelve thousand impressions per hour*. This machine, constituting as it does, an era in the history of printing, we have enjoyed the honour of naming "Hoe's Last Fast Press." The one we have has been in course of construction for us some months past, and is the first and only one yet built, commenced, or ordered, except by ourselves. The manufacturers already have our order for a second one of the same kind.

The essential principle of difference between this last invention and all other kinds of presses or machines hitherto used, con-

sists in the fact that while upon those the types are locked up with "quoins" and a "mallet and shooting-stick," in a "chase," and laid upon a "bed" of iron, the surface of which is flat; with this one the types are screwed up with a wrench, in what our compositors are pleased to denominate a "turtle," constituting both bed and chase, and placed upon a large cylinder, four and a half feet in diameter, more or less, which revolves upon its own axle within four other smaller cylinders, the fourth part the size of the larger one, these revolving also upon their own axles in an opposite direction.

Each one of these smaller cylinders receives from its supplying attendant the sheet of paper with which, at every fourth revolution, it meets the form or "turtle" of type as it comes round, and in passing, gives the impression, and instantly throws it out into the receiver's hands, above or below, according to the relative position of the cylinder.

Surrounding the large inner cylinder, to which the form of type is attached, and between those giving the impression, are placed the inking rollers, which spread the ink upon the face of the type as it revolves under them. There are two of these to each cylinder. The inking fountain is placed entirely underneath the machine, from which the ink is constantly drawn by means of a continually revolving small iron cylinder, forming itself a part of the fountain. From this the ink is taken up by means of small rollers, with a small vibrating distributor working in connection with them, and is conveyed to the surface of the large cylinder, the entire circumference of which, except that section of it occupied by the form of type, performs in its revolution the office of both distributor and feeder to the eight inking rollers, from which latter the types receive their supply direct.

With two of the cylinders the white paper is fed in above, and the printed sheets are thrown out below, and with the other two it is fed in below and thrown out above. The room taken up by the machine, paper-boards and all included, is about 16 feet in length, and 9 feet high by about 5 feet in breadth. The types used upon it are the ordinary types hitherto used upon the *Ledger*, which are made to assume a circular form in the "make up" by the use of beveled column rules.

For the attendance of this press ten persons are required, viz., a superintendent and an assistant, and four to feed sheets in, and four to receive them as they come out. This is the same number only that have been required to attend the two presses heretofore used in printing the *Ledger*.

We have now given, in brief, a description of the most important invention, by which we doubt not that printers, at least, if not mechanics generally, can derive a correct idea of its plan without the aid of a diagram.

All mechanics know that strictly rotary motion is the motion capable of the highest rate of speed in machinery. Hoe's Last Fast Press is constructed throughout entirely upon the rotary principle of motion. So still, indeed, does the machine move that it can hardly be heard in an adjoining room.

One of its greatest beauties as well as advantages in the estimation of all true mechanics is its great simplicity, being far less complicated than any previously used machine press.

The extensive manufacturing house of the Messrs. Hoe, to whom the printers of the United States are indebted for most of the printing presses and machinery in use in this country, and particularly for the rapid machine presses, was commenced by Robert Hoe in 1808, who died in 1832, and left his sons and Mathew Smith, who had been bred practically to the business, as his successors. Messrs. R. How and Co. have now in New York two very extensive establishments, one in Gold-street, and the other in Broome-street, in the upper part of the city, taking in the whole block bounded by Sheriff, Broome, and Columbia-streets. They have attached to their works an iron and brass foundry, forge shop and trip hammers. The whole machinery, foundry, &c., are driven by a single steam-engine, of a capacity to extend its power and work the entire length of the block, in which are employed between two and three hundred hands.

SEA WALLS—SHOULD THEY BE SLOPING OR VERTICAL?

Sir,—Of all the physical sciences, none is less aided by mathematics than the science of hydrodynamics. I do not know any authority on which to depend for formulæ adapted to the wants of the practical man: Eytelwein, Bossut, Venturi, and others of similar note, have paid attention to this subject, but their writings have but little if any practical application. Their data are for the most part derived from experiments made either with models or with canals of a regular geometrical figure, and under conditions easily defined. The resulting formulæ are therefore inapplicable to all natural and less regular currents; and the practical man must depend upon his own judgment and experience, and not

on scientific guidance, for all matters connected with the motion of fluids.

If the motion of a fluid in an open channel is so difficult of investigation, its motion in open space is placed quite beyond our researches. How much, then, should we be misled were we to endeavour to analyse a question, respecting which we have not even the advantage of comparative experiment, or were we to attempt to apply a mathematical investigation to a subject of which we only know the general principles. I have no idea of the liberty of the sea being restrained by the narrow bounds of analysis, or of the motion of the waves paying greater respect to a formidable array of symbols than it did to the commands of Canute.

"The wind bloweth where it listeth, and thou hearest the sound thereof, but knowest not whence it cometh nor whither it goeth." And these words of Scripture, literally true as regard wind, are equally applicable to the motion of the sea.

But though the exact science of mathematics cannot, in its strictness, be applied to this question, arguments founded upon general principles may lead us to results, and be as serviceable in directing the judgment and assisting practice, as the more exact conclusions of investigation.

It is with these ideas I sit down to pen this paper, intending to abstain altogether from mathematical investigation; for though now and then an equation may occur, it will be for the purpose merely of illustrating the general bearings of the question.

I will therefore now proceed to consider,

1st. The motion of the sea during a storm, and its mechanical action upon the face of a breakwater; and,

2nd. The action of the wall in resisting this force.

1st. The motion of the sea is a mechanical effect produced by the action of the wind sweeping horizontally over it; and as the direction of the recipient is always the same as that of the impelling force, the wind urges the water of the surface in the direction in which it blows. This may be seen by observing how the wind as it passes over a pond, urges the surface water to leeward: or it may be demonstrated from the oscillation of the waves of the sea during a storm. For what is a wave? How is it formed? A wave is an undulation of the sea, the crest of which is as much above as the trough is below the ordinary level. And it is caused by the heaping together of the water, (at first in a small degree) and thus disturbing the equilibrium of the surrounding parts. But how is it possible water should be thus heaped up without horizontal motion? What is it that urges the particles on the surface one over the other? How is a wave at *b* (fig. 1) to be formed, unless the particle at *a* be heaped on it; and if it is so,

Fig. 1.

must not *a* move from *a* to *b*? If, then, this motion be necessary for the *formation* of a wave, how much must its subsequent increase be influenced by the same cause?

As it is impossible to produce a wave unless by raising the particles of water above the ordinary level, so it is equally impossible for this to be effected by the wind unless by giving those particles a horizontal motion. And under these circumstances, it appears to me certain that the surface water of the sea in its normal state, hundreds of miles away from any shore, and uninfluenced from any foreign cause, must have a motion in the direction of the wind.

It appears also extremely reasonable to suppose, that since the wind is the cause of motion in the horizontal direction, it should decrease gradually but rapidly from the surface towards the bottom of the sea; and this supposition is corroborated by the fact that the sea acts with the greatest violence a few feet below the surface level, from which the force gradually decreases to the bottom.

Besides the onward motion of the water, there is the oscillation of the waves, which is subjected to the same law which governs falling bodies. The resultant of these motions traces a curve, and the particles of water move in the curvilineal direction thus traced.

As the oscillations of the wave are the result of a superincumbent pressure, its effects extend to a greater depth than that of the horizontal motion.

I have no intention here of attempting to trace the curve described by the motion of the water—it is sufficient for our present purpose to establish that there is

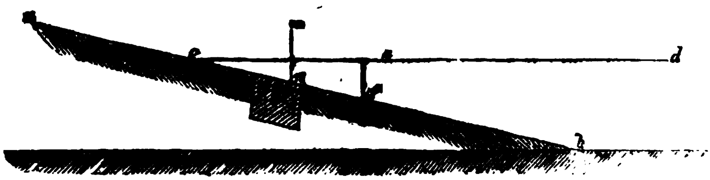
a horizontal force in the sea, and that it impinges upon a wall with a vertical profile (a few feet below the surface) at right angles or nearly at right angles, to its line of motion. In consequence of this, the wall must either stop the violence of the wave, or be swept away by it. And if it stop the wave, it must resist the whole of the force in it. Now, is it prudent to do this? If w = the weight of a wave, v = its velocity, $2g$ = the effect of gravity, then the violence of the blow, and the mischievous work done by it,

$$=\frac{w}{2g}v^2.$$

And this the wall must receive.

When the horizontal blow strikes upon the surface of a slope, it immediately becomes resolved into two other forces, one perpendicular and the other parallel

Fig. 2.



to the incline. Thus, if cd, fig. 2, be the direction of the impinging force, it would, upon striking upon the incline, be resolved into two other forces, one, ef, proportionate to the sine of the angle and perpendicular to the incline; the other, cf, proportionate to the cosine, and parallel with the incline.

One half the *vis viva* of the wave

$$=\frac{w}{2g}v^2;$$

and if, during impact, it be resolved into the directions ef and fc respectively, it follows that the amount of work and injury done by the wave upon the wall is

$$\frac{w}{2g}v^2\sin^2 ecf=\frac{w}{2g}v^2\,(1-\cos^2 ecf),$$

and the work remaining

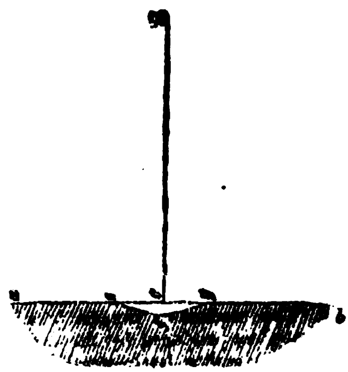
$$=\frac{w}{2g}v^2\cos^2 ecf,$$

sweeps up the incline, and expends its fury harmlessly in the air. It is a great mistake to imagine, because the sea is not so rough after it breaks upon a vertical face as it is when breaking upon a long slope, that the latter is therefore more liable to injury. The mischief done is proportional to the *vis viva* absorbed during impact, and inversely as that remaining in the wave after impact; it therefore follows, that the greater the violence of the sea, parallel to the face of the wall, the less is the mischief likely to accrue from it.

2. I have now shown, or at least endeavoured to show, that the sea strikes in a horizontal direction, and that a wall with a vertical profile receives a much heavier blow than one having a long sea slope. Let us now consider the action of the wall in resisting the effect of the wave. The material of which a wall is built, is always comparatively elastic, and this is shown by the recoil of a child's marble, after it is thrown against a hard surface—the recoil proving the elasticity of the stone.

This fact being admitted, let ab, fig. 3,*

Fig. 3.



be the vertical profile of a sea wall, cd the horizontal force of the wave striking against it; the effect of the blow is to indent or compress the masonry, as shown by the curve efg; but as soon as the pressure, cd, is removed by the reflux of

* The curve efg, is of course greatly exaggerated for the convenience of illustration.

the water, the tendency of the stone, h, is to resume its original figure.

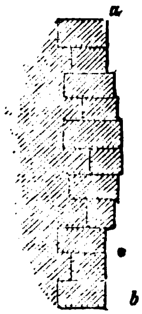
That part of the wall efg is, during the instant of impact, in equilibrium; for the force cd (the work done by which

$$=\frac{w}{2g}v^2)$$

is exactly balanced by the force exerted by the wall, by reason of its elasticity, to recover its original figure; so that, directly cd is removed, and the wave recedes, the force with which the stone recoils is

$$=\frac{w}{2g}v^2;$$

and, as there is nothing to support the face, ab, the stone is pushed from its bed, and the wall exhibits the appearance ab, fig. 4. Fig. 4.



This is the way all vertical walls in a sea-way fall. And, if you inquire of men living upon the coast, they will say something to the following effect:—"It is not the blow of the wave that destroys the wall; but when the wave goes back, it *sucks* it down." The wall must, therefore, depend for success upon its bond, for a much less force than is sufficient to destroy its equilibrium when impinging, will, by reason of the elasticity of the material, drag the wall after it.

The action of a wave upon the inclined surface is the same, though in a less degree, as I have shown above—the force acting perpendicularly to the plane

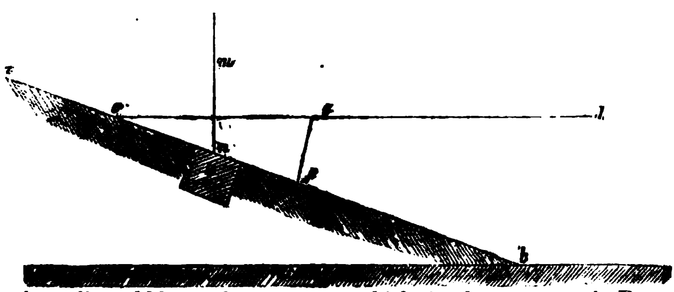
$$=\frac{w}{2g}v^2 \sin {}^2ecf;$$

which is, of course, less as the angle of the slope decreases. But, besides the less force which the wall has to resist, there is the weight of the material acting to prevent recoil; for if the recoil take place, say, at the stone B, it would evidently have to lift it through the space mn, instead of, as in the vertical wall, merely pushing it along in a horizontal direction.

This explains the paradox Mr. Smith alludes to, where a slope of 5 to 1 is said to stand, whilst the stones in one of 3 to 1 were swept landward.

For, take the slope, fig. 5, to be 18°, and the slope, fig. 2, to be = 11°, the force of the wave and of the elastic recoil of the

Fig. 5.



stone in the wall would be, in the former,

$$=\frac{w}{2g}v^2 \sin^2 18°;$$

in the latter

$$\frac{w}{2g}v^2 \sin^2 11°.$$

The stone, if removed from its bed, has to be lifted along mn, and the recoil has to act against the gravity of the stone, which, in the one case, is B cos 18°, in the other B cos 11°. The tendency, therefore, of a wave to loosen the stone is, in an incline of 3 to 1 (fig. 5,)

$$=\frac{w}{2g}v^2 \sin^2 18°—\text{B} \cos 18°,$$

and in a slope of 5 to 1 (fig. 2,)

$$=\frac{w}{2g}v^2 \sin^2 11° - \text{B} \cos 11°.$$

The stone B, therefore, in fig. 2, has the least chance of being thrown landwards. This, at least, is my view of the subject, though certainly it is by no means free from doubt.

I do not exactly understand Mr. Bell's remark. If he means that the recoil at the point *d* (*ante* page 78) would not take place *because the water is shallow*, he is wrong; for, it appears to me, this difference would not at all alter the conditions. But if he means to say, *that it does not take place because of the onward motion of the water*, I perfectly agree with him: his argument coincides with mine.

I had written so far before your last Number reached me which contains another communication from your able correspondent, Mr. Smith, on which I have several observations to make; but these I must reserve for a future paper.

Yours respectfully,

WILLIAM DREDGE.

10, Norfolk-street, Strand, August 10, 1848.

ON THE IDEA OF FORM TO BE ATTACHED TO THE HIGHER POWERS OF NUMBERS, AND ON THE SIGNS USED IN ALGEBRA.

Sir,—I think it not usual amongst mathematicians, to attach any idea of *form* to the higher powers of numbers. The following brief observations may, therefore, be not undeserving a place in your useful Magazine.

The *first* power of a number may be represented by arranging the objects in question in a linear manner; the *second* assumes the form of a square; the *third*, the form of a cube.

With this all are familiar; but it may not have occurred to all, that the *fourth* power of a number is represented by as many *such primary cubes* as is expressed in the original number, again arranged in linear order; that the *fifth* power is the square of this line of cubes: and that the *sixth* is its cube.

In like manner, the *seventh* power is the original number of this last or *secondary* cube, again arranged in linear order; the *eighth*, the square, and the *ninth* the cube of this last line, &c.

The young student in the mathematics is much puzzled about the signs + and − ; and I believe that older mathematicians are not always without feeling similar difficulty.

I think this puzzle will, as so many others do, resolve itself into the misuse of *terms*.

It may appear a little like cutting the Gordian knot in regard to *minus* quantities, as they are called, if I assert that, in reality, there is no such thing; yet it is certain, I think, that *minus*, and especially *negative* quantities, are mere fictions.

Is a, which is to be *subtracted*, a less *positive* number than a, which is to be *added?*

It is true, that a which is to be added, is always written simply a, and that a which is to be subtracted, is always written $-a$; but is not this a mere conventionalism; and ought they not to be written $+a$ and $-(+a)$ respectively? If we wish to subtract a second quantity, as well as the first, we actually write the sign + ; thus $-a-b$ *is*, in reality, and is usually *written*, $-(a+b)$.

So that there is, in point of fact, no minus or negative quantity; the quantity so designated is a plus quantity, which is to be subtracted; and numbers, instead of being designated plus and minus, positive and negative, should be regarded as all plus and positive, and as addenda or subtrahenda.

And thus, in an equation, we may transpose the terms from one side to the other, by considering them as equally positive, and to be marked, as addenda or subtrahenda, as the case may be.

So in addition and subtraction, and so in multiplication: thus $-a-b\times a-b$ is displayed in this manner:

$$\begin{array}{r} a-b \\ \underline{a-b} \\ a^2-ab \\ \underline{-ab+b^2} \\ a^2-2ab+b^2. \end{array}$$

$a\times a$ is obviously a^2;

$a\times -b$ is as obviously $-ab$, because b is to be subtracted; and, therefore, b times a, or a times b are to be subtracted.

In like manner $-b\times a$ is $-ab$, and to be subtracted for the same reason.

But $-b\times -b$ are b^2, and $+b^2$, because the *subtrahend* b is to be subtracted b times; that is, it is to be added b times; just as $-b$ *subtracted* from a makes $a+b$, and as b times $-b$ *subtracted* from a^2-2ab makes $a^2-2ab+b^2$.

To *subtract* a *subtrahend*, is the same thing as to add an addend. It may require, however, a slight mental effort

on the part of the pupil to realize this *double idea.* I am, Sir, yours, &c.,

TATROMATHEMATICUS.

London, August 20, 1848.

P.S. The sign − appears always to have a special reference to an antecedent number.

SEA WALL QUESTION — DESIGN FOR THE COMBINATION OF A LONG SLOPE WITH UPRIGHT ASHLAR FACE.

Sir,—In the papers which I have recently troubled you with upon the subject of sloping sea faces, it may be observed that I entirely confine myself to investigating and pointing out what appeared to me, after close consideration, to be the leading defects of the long sea slope, and the insufficiency of many conclusions hastily drawn respecting it. In the most ordinary affairs of life, no plan or system should be condemned, or even depreciated, without due deliberation as to its merits or demerits; but in the instance of the discussion upon the relative efficiency of sloping and vertical sea faces, that attention was rendered still more necessary on account of the conflicting opinions enunciated by men, whose eminence and professional fame must always impart a factitious character to any proposition they may be pleased to espouse.

Having, therefore, given in a previous communication what appears to me sufficient grounds for dissenting from the principle of the long sea slope—having, as I believe, shown that the long slope carries within itself the seeds of its own destruction—permit me to submit, for the consideration of those interested in such matters, the annexed cross-section of the form of construction, which appears to me, under all circumstances, the most suitable for the face of a break-water in an exposed position and deep water.

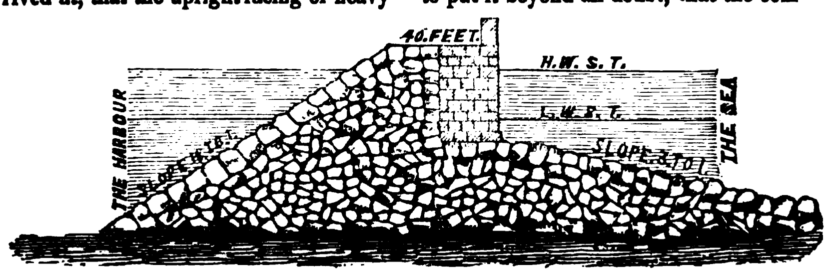
In submitting this compound form, it is not to be supposed that I compromise in the least the convictions I have arrived at, that the upright facing of heavy ashlar work is, of all forms, the best adapted to resist the shocks of the most violent seas. Difficulty in execution does not affect the principle of construction; and were it possible to carry up the vertical face from the bottom of the sea with the requisite degree of care, and also to secure the stability of the foundations beyond all doubt, I should at once propose to do away with the front slope, and build upright from the bottom level. I therefore adopt the front slope, not on principle, or as the best mode of construction, but merely as an expedient to avoid important practical difficulties, and as the readiest means of securing the following advantages:

First, It removes all doubt which can possibly be suggested as to the stability of the foundations.

Secondly, It obviates the trouble and expense which would be attendant upon setting the upright work with the requisite degree of care in deep water.

Thirdly, Because all experience shows that front slopes descending from low water are not subject to injurious effects even in violent gales; and therefore in that position, this inferior mode of construction is sufficient.

In adverting to the combinations of forms for the sections of breakwaters, it may not be irrelevant to point attention to the circumstance, that in many parts of the Protest of Sir Howard Douglas (vol. xlviii., p. 564), the author would appear to draw an argument in favour of his peculiar views of the long sea slope from the *combination* of forms recommended for the adoption of the Dover Habour Commissioners. Now the fact is, that those forms and that submitted in this paper are in reality more at variance with the combinations advocated by Sir Howard Douglas, than is the upright face itself from the bottom of the sea. It is no business of mine to show that the argument of Sir Howard fails in the case to which it is applied; but I feel desirous to put it beyond all doubt, that the com-



posite form given in the accompanying section is no compromise of the principle of the upright face; and can never be taken to furnish an argument in favour of a long sea slope.

Referring to the section, the upright work there shown is contemplated to be founded at the level of a few feet under low water spring tides, to be composed of heavy ashlar masonry of sound natural stone; the blocks to vary from three to five tons in weight; the beds and joints roughly punched fair out of winding, dowelled, and set flush in best cement. The whole of the lower portion, and part of the backing of the upright work, to be formed by dropping out of vessels in the ordinary way, natural rubble stones as they come from the quarry, in blocks of from two to four tons weight; the basement to be allowed sufficient time to consolidate before the upright work is commenced.

I shall now endeavour to give some defined notion of the stability of the structure I have above described, and its resistance in opposition to the shocks it would be subjected to; taking care, however, to maintain an ample excess of security.

As we know the momentum of the waves increases towards high water, let us suppose it greatest at the point where the line H. W. S. T. (*high water spring tides*) enters the front of the wall, which point we shall suppose also 10 feet below the base of the parapet or surface of the wharf; and let us also suppose this ashlar facing to be 20 feet thick from the front to the back of the wall. Now, if we take an area of one square foot upon the face of the wall, and suppose it extended to the back, it will generate a horizontal column of 20 cubic feet of stone; but each foot of this column suffers a superincumbent pressure of 10 cubic feet; therefore the pressure upon the under surface of the entire horizontal column is the weight of

$$20 \times 10 = 200 \text{ cubic feet.}$$

I might with safety take the *friction* upon a unit of surface of this material at *one-third* of the superincumbent weight, exclusive of the advantage to be derived from the cement; but I shall calculate only upon one-third, including *friction* and *cohesion*. Therefore, each square foot of area upon the upright face will give a resistance throughout the breadth of the wall equal to the weight of 226 cubic feet; and taking 18 feet of this material equal to a ton, we find that each square foot upon the face of the wall, *at the point of least resistance*, presents an opposing force to any horizontal shock equal to 20½ tons, exclusive of the additional resistance afforded by the backing.

It appears from the experiments of Mr. Thomas Stevenson (vol. xlviii., p. 436,) that the maximum result registered by the marine dynamometer in a heavy gale at the Skerryvore Rocks, was about three tons upon the square foot. That gentleman has, however, suggested in his valuable paper many reasons sufficient to incline one to the opinion that a heavy sea impinging upon the broad face of an upright obstacle may develope a much greater force per unit of area than that exhibited by the more confined disc of his instrument. It may be also said, that as the resistance of the wall is of the nature of pressure, it is an established principle that a pressure, however great, must yield to a force of impact, however small. Be it so; but it will be for others to expand these speculations into such intelligible terms as to show that the excess of resistance above exhibited is insufficient for security, even were the dimensions of the ashlar facing considerably reduced.

I shall now, Sir, take leave of this subject. I respectfully invite the attention of your readers to the consideration of the upright ashlar face, and request them to show where any force ever known to have been exerted by the waves of the sea, can possibly break it. Little more than *one-fourth* the quantity of material required for the long sea slopes will suffice for this form of breakwater; and whereas those sloping masses, as shown before, are liable to be carried away in detail, the upright ashlar face presents a form enduring as the materials of which it is composed. In the graphic language of your esteemed correspondent, Dr. M'Cormac, "The sea may boom and roar for ever, or so long as the living rock endures, without entailing injury (upon the upright ashlar face), and consequently without entailing fresh expense."

Respectfully yours,

T. Smith.

Bridgetown, Wexford, August 10, 1848.

MATHEMATICAL PERIODICALS.

(Continued from p. 7, vol. xlix.)

IX. *The Leeds Correspondent.*

Origin.—This excellent periodical was commenced at Leeds, in January, 1814, and was concluded with No. 3, vol. v., in July, 1823. It professed to be "similar in its general plan, and in the subjects which it embraced," to the *Quarterly Visitor* and the *Enquirer*, but different from them "in what its conductors considered to be a more commodious disposal of some parts of the materials."

Editors.—1. Mr. James Nichols; the literary department was under his care, and he was also the proprietor of the work.

2. Mr. John Ryley, teacher of the mathematics, Leeds; he edited the mathematical department in Nos. 1 to 4, vol. i.

3. Mr. John Gawthorp, of Leeds; editor of the same department in Nos. 1 to 3, vol. ii.

4. Mr. John Whitley, editor of the same department from No. 4, vol. ii., to the conclusion of the work.

Contents.—Each number of the first three volumes of the work contained two divisions, respectively adapted to junior and senior correspondents. The former consisted of English themes, Latin and French extracts, translations, &c.; the latter contained poetry, both original and selected; miscellaneous essays; interesting and instructive extracts from various authors; philosophical and grammatical queries: reviews; biographies, &c., &c. The formal proposal of queries was discontinued with vol. ii., and in the last two volumes the juvenile literary department was omitted, and its place supplied by reviews of various publications. A series of extracts, under the head of "General Scientific Information," was also added, which contained a large amount of valuable information. The mathematical department contained a few essays, a series of "Questions for Youth," and "Mathematical Questions" for the exercise of senior students. Much good taste was exhibited by the editors, who were eminently successful in producing one of the most useful and valuable of the English periodicals.

Among the many interesting contributions may be enumerated, "An Essay on Music;" "On Attempts at Universal Empire;" a series of amusing papers relative to mishaps of an absent mathematician, by Mr. Timothy Triangle;" "The History of four Potatoes," by the same; "On the Copiousness of the English Language;" "Heights of the most remarkable Hills in Great Britain and Ireland," by Mr. John Baines; "On the Migration of Swallows;" "On Geometry and Mechanism in Nature;" "Characters of George III. and his Queen;" "Difference of Style between Addison and Johnson;" "A Dissertation on Forks," from Beckman's Inventions; "Female Mathematicians;" "On Wit and Humour," &c., &c. Many of the themes and translations are also well worthy of notice did space permit. Among the biographical notices are, Memoirs of Mr. John Ryley, Mr. Henry Andrews, John Rennie, Esq., F.R.S.; and in the reviews are some excellent, and occasionally severe, remarks on Byron's "Sardanapalus," "The Two Foscari," and "Cain;" Dr. Pearson's "Life of Wm. Hey, Esq., F.R.S.;" Irving's "Bracebridge Hall;" Cunningham's "Traditionary Tales;" Deacon's "Innkeeper's Album;" Scoresby's "Journal of a Voyage to the Whale Fishery;" Dr. Johnson's "Life and Writings of William Hayley, Esq.," &c. The mathematical papers consist of, "A New Method of Extracting the Cube Root," by Mr. John Blaymires, of Eccleshill; the investigation of a fluxional expression given in question 15, vol. i. *Math. Repos.*, N. S., by Mr. Jonathan Mabbott, of Manchester; a Reply to some Remarks at page 36 of the *Ladies' Diary* for 1817, by Mr. John Gawthorp, of Leeds; "A new and Expeditious Method of Proving the Square and Cube Roots," by Mr. Samuel Taylor, of Wooley, &c. In No. 3, vol. iii., a Mathematical "Prize Question" was proposed, the true answers of which stood a chance by lot to win six numbers of the *Correspondent:* the practice was continued in all the following numbers, the successful candidates being, in the order of date:

Mr. Samuel Johnson, of Apperley Bridge.

Mr. William Wright, of Hull.

"Amicus" (Mr. Whitley,) *without a competitor*.

Mr. J. H. Swale, of Liverpool.

"Amicus," *no competitor*.

Rev. Price Bronwin.

"Amicus," *no competitor*.

Rev. Brice Bronwin, *no competitor*.

"N. Y." (Mr. Whitley,) *no competitor*. This question was a geometrical one, proposed by Mr. Swale, and is referred to by Mr. Whitley in his solution to the prize question in the *Ladies' and Gentleman's Diary* for 1841.

T. W.

Burnley, Lancashire,
Aug. 17, 1848.

(*To be continued.*)

THE NEW FRENCH BAROMETER.

At one of the recent meetings of the British Association at Swansea, Professor Lloyd having been requested by several members to describe a barometer on a new principle which he had lately seen, said that it was a French invention. "A cylinder of copper, with a very thin and corrugated end, was partially exhausted and hermetically sealed; and the effect of the varying pressure of the atmosphere on the thin end was magnified by a system of levers, so as to affect the index of a dial very little larger than a watch-dial. A friend of his had tested the indications of the instrument by placing it under the receiver of an air-pump, and observing its march in comparison with the indications of the long gauge, and found them to agree to less than the 1-100th of an inch."

The barometer referred to was patented in this country, April 27, 1844, by Mr. Fontainmoreau, on behalf of the inventor, from whose specification we extract the following complete description.

This new mode of constructing barometers and other pneumatic instruments, consists more especially in the application of thin sheets or diaphragms of metal, glass, India-rubber, or other flexible air-tight substances, to certain apparatus employed for measuring the pressure and elasticity of the air and other fluids, in such manner as to form a kind of elastic cushion, or buffer, susceptible of the slightest variation of the pressure of the atmosphere or fluid with which it is in contact, and consequently indicating the amount of the same by the greater or less depression of the said yielding substances. And the invention consists generally in the application of the above principle to all those pneumatic instruments, in which any reciprocating motion and oscillation takes place upon a variation in the pressure or weight of the superincumbent column of the atmosphere, or in the pressure of the liquid in which it is immersed, or in the elasticity of a gaseous body, and which instruments are commonly called barometers, manometers, &c.

I will proceed to describe the engravings appended hereto, explaining in the course of the description the working action of the apparatus which is therein fully delineated. Fig. 1, is a diametrical section of the barometer; fig. 2 being a horizontal view of the same, with the dial plate, M, taken off, in order to show the arrangement of the sheet B and the cup G.

The instrument is constructed of brass or any other suitable material impervious to air. The lower part, AA, is a hollow box stoutly made, and strengthened by radial brackets, HH, soldered internally to insure rigidity in AA. This box is covered in an air-tight manner by a sheet or diaphragm, BB, of metal, glass, &c., very thin that it may be the more flexible, and also corrugated circularly, so as to enable it to be depressed or elevated to the greatest extent requisite without rupture. Underneath this diaphragm, BB, are flat annular discs, E, E, E, made up of segments or in entire plates, which serve as caps to a number of spiral springs for the purpose of supporting it against the atmospheric pressure. The lower ends of these springs, six of which, C, C, C, C, C, C, may be seen in the engraving, are inserted in the cavities cut for them in the false bottom, D, D, D, D, D. They communicate their pressure to the discs, E, E, E, which diffuse it equally to all parts of the delicate diaphragm.

And I would here remark that I do not confine myself to the spiral form, since I can use steel plates, folded in a zigzag manner, in lieu thereof.

In the centre of the thin diaphragm, BB, a round hole is cut, and its edges soldered to the lips of a small capsule or cylindrical cup, G, which projects into the interior of the hollow box, AA, sufficient space being allowed between G and D to permit it to be depressed to its greatest required deflexion.

In the bottom of the box, AA, and immediately under the cup, G, there is a small aperture, Z, for the purpose of exhausting the air from the box, AA.

This is accomplished in the following manner:—A little solder is spread round the hole, and a flat-headed peg inserted therein, sufficiently open to permit the passage of the air. The diaphragm, BB, with the springs, C, C, C, C, C, C, is compressed to its proper position by means of a board, and is then soldered or cemented to the box,

AA, being retained in its place by clamps embracing the board and bottom of the instrument, which, in this state, is to be placed under an air-pump receiver to which has been previously fitted an air-tight stuffing-box, through which passes a smooth rod, capable of moving freely within it. The inner extremity of this rod bears a soldering-iron, which must be treated before commencing to exhaust. This done, all is ready

Fig. 1.

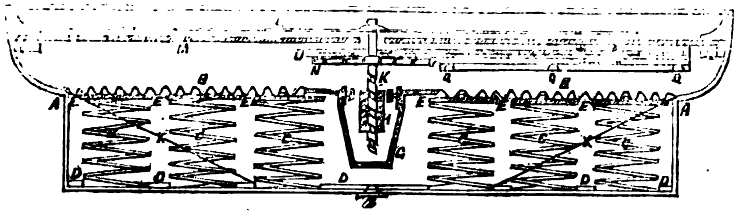


Fig. 2.

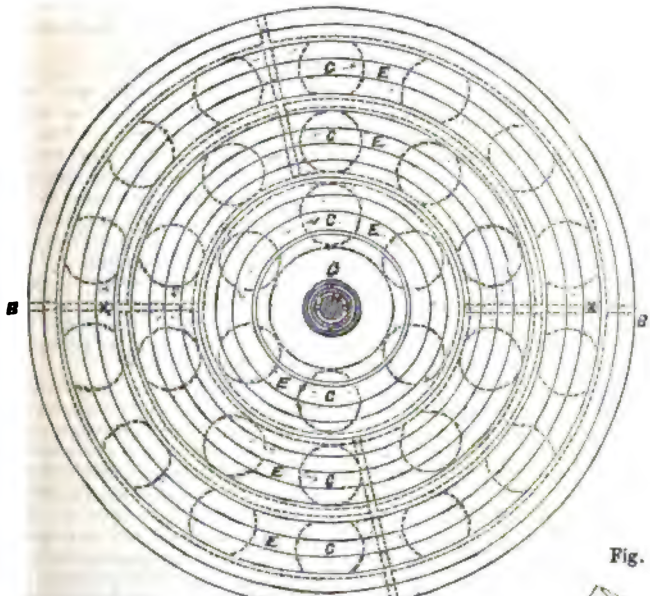


Fig. 3.

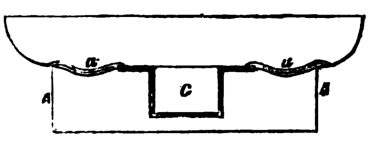
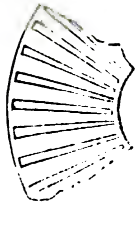


Fig. 4.



for the operation of the air-pump; and when the vacuum is obtained, both in the instrument and in the receiver, since they are in communication by the hole, Z, the hot iron must be pressed down upon the peg at Z, and its heat will cause the solder to melt

around the peg, thereby making a complete and permanent joint. The peculiar adaptation of this barometer to its intended object, before I proceed further, will be clearly seen. The pressure of the atmosphere being removed from the under surface of the thin diaphragm; but this weight being variable, according to the state of the weather, consequently, the amount of depression will be greater or less in proportion to its variation. Therefore, all that is required to complete the instrument, is simply to provide mechanism for accurately measuring this depression and exhibiting its amount on a dial or other ordinary scale. The contrivance which I have adopted for this purpose is very simple. In the before-mentioned cup, G, is placed a small nut, H, with an internal screw-thread. This nut is suspended upon a kind of universal joint, which will be better understood by a reference to fig. 2. The nut, H, as there seen, is not directly attached to the cup, G, but is balanced and plays freely on two pivots projecting from a ring, which, again, is balanced on two other pivots at right angles to the former ones, and connecting the whole with the cup, G. This arrangement allows for any accidental deviation from precision which may occur in fitting together the several parts. A vertical screw, K, works in the nut, H, or rather is worked by it; for when the cup, G, is depressed, the nut, H, catches the thread of the spindle, K, and causes it to turn round; when the cup, G, is elevated, the spindle naturally turns in the reverse direction. The upper end of the spindle, K, passes through the dial-plate, M, and carries the index, L, which exhibits its variations upon a scale graduated in inches, or any other convenient standard.

And here I would again observe, that I do not limit myself to the above arrangements, since I can employ for the same purpose a rack and pinion, or a chain and pulley, with two bevel wheels, or a simple lever; the dial-plate being placed at right angles to the diaphragm (see fig. 6,) in which the rack and pinion may be replaced by a chain and pulley. The influence of heat and cold in expanding and contracting metals would, however, disturb the regularity of its action and the faithfulness of its indications, if not corrected by some means. When the increase of temperature of the diaphragm causes it to rise, it indicates, erroneously, a light state of the atmosphere.

This error is counteracted by a regulating plate, O, made of two strips of different metals, brass and steel for example; the upper one, expanding less than the other, is fixed at O, O, O, a small space being left between it and the dial, M. One end of this plate projects as far as the centre of the diaphragm, when a small hole is bored for the spindle, K, to pass through.

Upon this spindle a collar is fastened, immediately under and abutting against the plate, O, which collar, in addition, is provided with a coil-spring, N, in order to keep it gently in contact with the said plate, and therefore steady in the nut, H. When, from expansion by heat, the cup, G, is elevated, the temperature also acts upon the plate, O, which, on account of the unequal expansion of the two metals of which it is composed, curves upwards to a degree proportional to the heat, and equal to the height which the cup, G, has risen at the same moment.

This permits the spindle to rise higher, instead of being turned, as would be the case if it were held down while the cup rose.

When the apparatus is under the effects of cold, the mechanism will naturally act in the reverse manner, thus compensating for all foreign influences. The proportion of this compensation may be lessened or increased by slipping the wedge, P, nearer to or further from the spindle, K; the screw, Q, Q, Q, being placed so as to hold it firmly in the required position. This approaching or receding of the piece, P, shortens or lengthens the play of the regulating plate, O, and thus raises the amount of its deflexions; and when the proper position is once obtained, it must be permanently fixed there.

To graduate the instrument, I place it in a bell-plunged mouth downwards in a liquid, in the same manner as a gasometer. This vessel is provided with a manometer; and I vary the pressure by raising and lowering it, noting at the same time the arcs which the index, L, describes upon the dial, M, in consequence of the said variations. It will be seen that in the application of my principle to various useful purposes, any elastic, and, at the same time, air-tight diaphragm, may be used, and also that it does not require any variable form of apparatus for the successful operation of the said principle. In exemplification of this, I subjoin some modifications of the above arrangement. These are shown in figs. 3, 4, 5, and 6.

In fig. 3, in lieu of the corrugated diaphragm, BB, I substitute one of copper, *a a*, in shape like an annular trough, pierced with radial slots, as will be observed in the enlarged segment exhibited at fig. 4. This annular trough is coated with lamina of caoutchouc, and the outer edge is cemented to the box, AA, the inner edge being at-

Fig. 8.

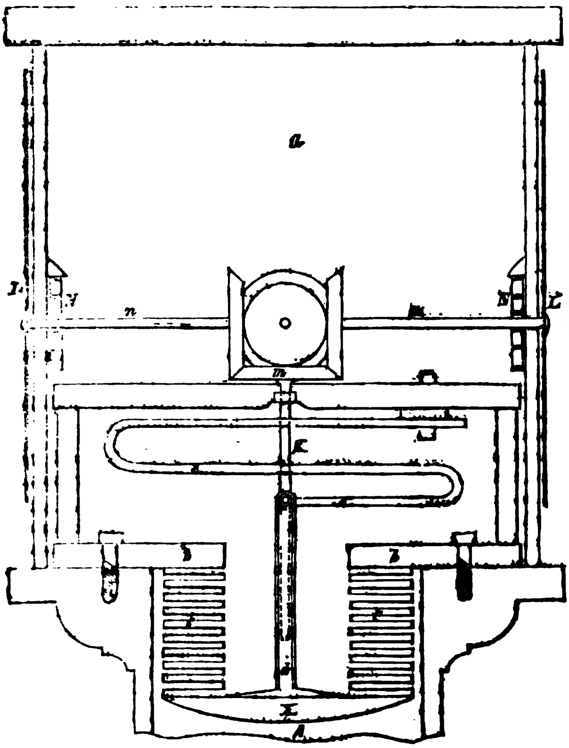


Fig. 9.

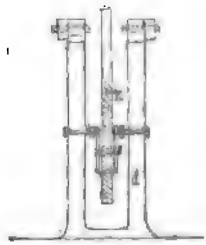


Fig. 11.

Fig. 5.

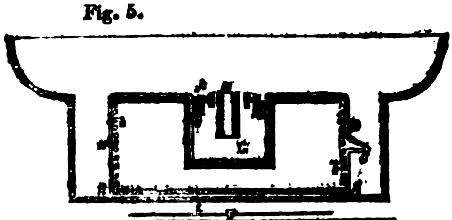


Fig. 7.

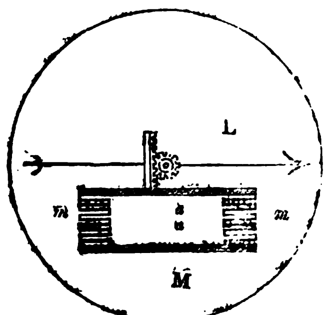


Fig. 6.

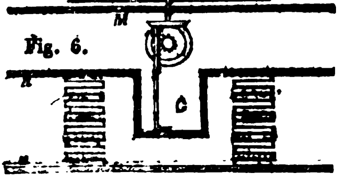
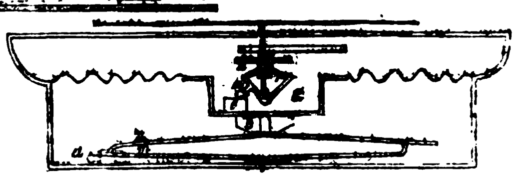


Fig. 10.



tached to the cup, G, which, with the rest of the mechanism, is similar to that of fig. 1, and for the same purpose.

Fig. 5 represents two plates, connected, and entirely enveloped by a coating of caoutchouc, or other supple material. The cylindrical tube of caoutchouc, *aa*, is kept distended by an internal spiral coil of wire, *bb*. The lower plate is fixed to the bottom of the box, AA, and the upper one carries the cup, G, in which is seen a nut, C, with a slightly conical screw-thread, for the purpose of receiving a tightening-screw, *f*, which last supports the universal joint of the nut, H, as above described. The air is exhausted through the India-rubber pipe, C, which is strengthened by an internal lead tube, coated with wax. When the vacuum is complete, the pipe, C, must be pinched, and the projecting portion cut off, and the place finally sealed with caoutchouc.

Fig. 6 represents two plates, *aa*, similar to the above, connected by a deeply corrugated tube of metal, glass, or other suitable material. The cup, G, carries a rack, to work into a pinion above it, which last communicates its motion by means of two bevel wheels fixed to the dials, to the index, L, or, if the axis of the tube, *mm*, be placed (as shown in fig. 7) parallel to the dial, the pinion may be fixed upon the axis of the index, L, and the bevel wheels dispensed with. This mechanism may also be applied to the other modifications of my apparatus. If the flat projections of the tube, *mm*, be thin and large, I give strength by stamping each of them with radial corrugations.

In all these forms, if the diaphragm be not alone sufficiently strong, springs must be employed, either internally or externally, between the projecting portions of the upper and lower plates (as at *aa*, fig. 6;) or, instead of springs, the air may be left in the box, AA; but, in this case, greater play must be given to the bimetallic regulator, in order to compensate for the expansion of atmospheric air.

The principle, as above exemplified, can also be applied to the construction of manometers for measuring the pressure or elastic force of gas or steam. An arrangement for this purpose is seen in fig. 8. A is a hollow column, communicating by its base with the boiler or reservoir of the fluid to be measured. The top of this column is covered in steam-tight by the cover, *bb*, in the centre of which is attached the corrugated tube, *cc*. The bottom, H, of this tube, according as it is more or less compressed by the steam, raises the standard, *a*, which abuts against the spring, *ee*. This standard is forked, as shown in the side view, fig. 9; and between the two branches is suspended, on an universal joint, a nut, H, which, in rising or falling, turns the spindle of the screw, K. This spindle carries, at its upper extremity, a pair of bevel wheels, *m*, which, by communicating with four other bevel wheels, transmit the indications through their axes, *nn*, and indices, LL, upon the four faces of the box, G. I can also employ as a manometer the arrangement represented for the barometer, with this difference, that the springs must be placed between the flexible diaphragm, BB, and the dial, M, the steam or gas being introduced into the interior of the box, AA. It is farther obvious that the arrangement before described may be applied to measuring the pressure of liquids at different depths.

THE BRITISH ASSOCIATION—SWANSEA MEETING.

We extract the following additional Notices from the *Athenæum.*

Application of the Gases evolved from Blast Furnaces to Heating Purposes.

By Mr. J. P. Budd.—It appears that the gases which are evolved from these furnaces escape at a temperature which is about the melting point of brass. In the iron works at Ystalyfera, where the iron is smelted by the use of anthracite coal, advantage has been taken of this in a most ingenious manner. By an arrangement, which is in its character exceeding simple, but somewhat difficult to describe without a model, (Mr. Budd's description was illustrated by a very nicely constructed one,) the hot gas is led off into another channel by means of a strong current generated through a chamber and air-way from a point just below the top of the iron furnace. It is conducted, very little heat being lost in the passage, under the boiler of a steam-engine; and it is found to be at a sufficiently high temperature to heat the boiler without the consumption of any fuel whatever. Hence an immense saving is effected. Although only one furnace and one boiler has hitherto been adapted to this purpose, it is found to effect a saving of 350*l.* a year. We may consequently expect that when the experiment is further extended and more of the furnaces so arranged that this heat may be economized and employed for the numerous useful purposes to which it is applicable in a large establishment, the saving will amount to many thousands annually.

The Cutting Property of Coke.

By Mr. J. Nasmyth.—The following interesting fact was discovered some years ago, and it appears to furnish additional evidence as to the identity of the diamond with carbon, namely, that *coke* is possessed

of one of the most remarkable properties of the diamond, and in so far as it has the property of *cutting glass*. I use the term "cutting" with all due consideration—in contradistinction to the property of scratching, which is possessed by all bodies that are harder than glass. The *cut* produced by coke is a perfect clear diamond-like cut, so clean and perfect as to exhibit the most beautiful prismatic colours, owing to the perfection of the incision. Coke hitherto has been considered as a soft substance, doubtless from the ease with which a mass of it can be crushed and pulverized; but it will be found that the minute plate-formed crystals, of which a mass of coke is composed, are *intensely hard*, and as before said are possessed of the remarkable property of *cutting* glass. This discovery of the extreme "diamond-like" hardness of the particles of coke will, no doubt, prove of value in many processes in the arts, as well as interesting in a purely scientific sense.

In a conversation which ensued, it was stated by Mr. Chance, of Birmingham, that in all probability the knowledge of this fact would lead to a saving of nearly 400*l.* a year in their establishment alone.

Hydraulic Pressure Engines.

By Mr. J. Glyn. The following mode of employing the power of waterfalls in a most useful and important manner, has been too long neglected in this country, considering the advantages it affords in hilly districts for the drainage of mines; namely, the application of high falls of water to produce a reciprocating motion, by means of a "pressure engine." The pressure engine acted by the power of a descending column of water upon the piston of a cylinder to give motion to pumps for raising water to a different level, or to produce a reciprocating motion for other purposes. The pressure engine was calculated to give great mechanical effect in cases where waterfalls may be found of much too great a height and too small a quantity to be practically brought to bear in a sufficient degree on waterwheels within the ordinary limits of diameter. The author produced instances of the desired pressure engine, one of which was constructed, about forty years ago, in Derbyshire—and which he believed was still at work in the Alport Mines, to which it was removed from its original situation. The cylinder was, he believed, 30 inches in diameter. In 1841, Mr. John Taylor advised the application of another and more powerful engine at the Alport Mines, which was made under his (Mr. Glyn's) direction, at the Butterly Ironworks, in Derbyshire. This was the most powerful engine that had been made. The cylinder was 50 inches in diameter, and the stroke 10 feet. It was worked by a column of water of 132 feet in height, so that the proportion of power to act on it was as the area of a piston to that of the plunger—namely, 1,963 to 1,385, or fully 70 per cent. The superintendent of the machinery assured him that the engine had never cost them £12 a year since it was erected. Its usual speed was about 5 strokes per minute; but it was capable of working at 7 strokes per minute, without any concussion in the descending column, the duty actually done being equal to 163 horse-power:—Area of plunge, 9·621 feet × 10 feet × 7 strokes = 673·41. 673·41 × 62·5 × 132 = $\frac{5445582}{33000}$ = 163 horse-power. The author concluded by remarking that, in this case, as in all others when water acts by its gravity or pressure, those machines do the best work when the water enters the machine without shock or impulse, and quits it without velocity. They thereby obtain all the available power that the water will yield with the least loss of effect; and this result is best accomplished by making the pipes and passages of sufficient and ample size to prevent acceleration of the hydrostatic column.

Gutta Percha Manufactures.

By Mr. Whishaw. Contrary to the general opinion that gutta percha is a simple substance, Mr. Crane has found it in its ordinary state to consist of at least two distinct materials, besides a notable proportion of sulphur, viz., 1. A white matter, gutta percha in its pure state; 2. A substance of a dark brown colour. Various experiments were made to ascertain its strength when mixed with other matters, and also as to what pigments would mix with it without rendering it brittle or deteriorating its qualities. From these it appeared that the only(?)pigments that could altogether be relied on to be used with gutta percha were orange lead, rose pink, red lead, vermilion, Dutch pink, yellow ochre, and orange chrome. Under the influence of heat and pressure, gutta percha would spread to a certain extent, and more so if mixed with foreign matters. All the mixtures composed of gutta percha and other substances which had been subjected to experiment, except that containing plumbago, were found to increase its power of conducting heat; but in its pure state gutta percha was an excellent non-conductor of electricity. The best composition for increasing the pliability of gutta percha was that formed in conjunction with caoutchouc tar, (caoutchicine,) and next in order that of its own tar; (gutta perchine?) and the best material at present known for moulding and embodying was obtained by mixing gutta percha with its own tar and lamp-black.

Whishaw's Telakouphanon or Speaking Trumpet.

Mr. Whishaw exhibited the Telakouphanon, or speaking trumpet; and in doing so, said that speaking tubes of gutta percha were quite new, as was also the means of calling the attention by them of the person at a distance, which was accomplished by the insertion of a whistle, which, being blown, sounded at the other end quite shrilly. Attention having been thus obtained, you remove the whistle, and by simply whispering, the voice would be conveyed quite audibly for a distance of at least three-quarters of a mile, and a conversation kept. It must be obvious how useful these telegraphs must become in large manufactories; and, indeeed, in private houses they might quite supersede the use of bells, as they are so very cheap, and by branch pipes could be conveyed to different rooms:—and, indeed, if there were no electric telegraphs, they might, by a person being stationed at the end of each tube of three-quarters of a mile or a mile, be made most speedily to convey intelligence for any distance. In private houses the whistle need not be used, but a more musical sound could be produced. He then amused the auditors by causing the end of the tube, which was of the length of 100 feet, to be inserted into the mouth-piece of a flute held in a person's hand, regulated the notes, and placing his own mouth to the other end of the tube, "God save the Queen" was played at a distance of 100 feet from the person giving the flute breath. Turning to the Bishop of St. David's, he said that in the event of a clergyman having three livings, he might, by the aid of three of these tubes, preach the same sermon in three different churches at the same time.—[See *Mech. Mag.*, vol. xlvi., p. 205, and vol. xlvii., p. 545, for the groundwork of this suggestion.]

Progress of Steam Ship Building.

By Mr. J. Scott Russell. A few years ago steam-vessels which would go ten or twelve miles an hour were deemed fast ships; now, however, we had attained a much higher rate of speed. Vessels were then built on the old-fashioned principle that the water-line should be nearly straight, and that the run of the vessel should be a fine line, and that there should never be a hollow line, except a little in the run of the ship, but that there most certainly should not be any hollow line in the bow, for there the water-lines should be straight, or a little convex. Researches and inquiries were, however, made by a Committee of the British Association as to the form which would enable the vessel to go fastest through the water. These inquiries lasted for years, and established, by a series of experiments, a set of very curious facts. Formerly, every builder of ships had his notion of proportion; some that the length should be four times the breadth—others that it should be 4½ or 5—and some went as far as to say that the length should be six times the breadth, but these were deemed innovations; so that although the proportions of width as compared with breadth were said to be fixed ones, yet strangely enough every one differed as to those proportions. Another question was what part of the vessel should have the greatest width, and it was generally thought that the greatest width should be nearest the bow. Some daring persons had, however, put it back as far as the centre of the ship, This was, however, the exception, and not the rule. Then there was another great principle, which was that the bow and the stern should exactly balance each other—that is, that the vessel should be equally balanced; but the new rules which the British Association had established were as follows:—They began by upsetting the old rule with respect to the proportions which the length should bear to the breadth, finding that the greater the speed required the greater should be the length, and that the vessel should be built merely of the breadth necessary to enable the engines to be put in, and to stow the requisite cargo. Then the second great improvement made by them was that the greatest width of water line, instead of being before the middle, should be abaft the middle of the vessel, and in fact two-fifths from the stern, and three-fifths from the bow. The next great improvement was that, instead of having the bow broad and bluff, or a cod's head bow, for the purpose of rising over the wave, you might have hollow water lines, or what are called wave lines from their particular form, and with that form the vessel would be propelled with less power and greater velocity—and also that instead of keeping to the old fine run abaft, and cutting it away, you might with great advantage have a fuller line abaft, provided it was fine under the water. Thus, by these improvements, the form of the old vessel was pretty nearly reversed, to the great annoyance of the old school, and the steamers were given large and commodious cabins and after holds, instead of having cabins so pinched in that you can hardly stand in them.

Another heresy, introduced by the British Association, was that of the principle as to the balance of the stern and the bow upon which they now rested; but which was founded in a most singular error, for they left out something which was very material. They concluded that the wave acted equally

on both ends of the vessel in striking it; but they did not take into consideration the impossibility of this when a vessel was moving, not having taken into calculation the velocity of the wave or of the vessel, and that from this circumstance the concussion from a wave striking the bow would be a most powerful one, while it could not be so with regard to the stern, because if the velocity of the wave meeting it was fifteen miles, the shock would be as of thirty miles; and, therefore, it became most plain that the bow would give the greatest resistance to the wave. He had examined all the fastest steamers, which had accomplished fifteen to seventeen miles an hour—and in smooth water eighteen miles an hour; and he would venture to state that there was not one of them which accomplished from fifteen to seventeen miles an hour, which had not all these alterations in every particular, and that the wave form and wave principle were now adopted by all the great steam-ship builders, and that all the fast steam-boats had what was called the wave bow. Now, of the eight boats on the Holyhead and Dublin stations, if examined, it would be found that all of them were built on these principles, although in some of them there was still left a little of the old principle, some of the boats being made a little fuller and more straight; and if any one would look at one of these boats, it would be perceived that the moment they moved, the very wave itself rebelled against them and broke against their bows,—and that, consequently, these were slower than any of the others. All of them, however, were vessels of the first class; and he gave the details of their construction,—for which we have not space. All of them were examples of the value of the form and the principles which the British Association had advocated and introduced at a very early period of its history.*

Mr. J. Taylor stated, that as Treasurer of the Association, he could bear witness to the value of the efforts of the Association in this direction; and he felt bound in justice to state, that the credit Mr. Russell had given to the Association was chiefly due to himself, as the individual who, with the late Sir J. Robinson, had conducted the investigations on this subject.

Mr. J. Price rose to say that he agreed with Mr. Russell in all that he had adduced. There was, however, one mode of steam navigation—one mode of propulsion to which he had not alluded; he meant the mode of propulsion by the screw propeller. He would, therefore, mention that they had built a little vessel called the *Neath Abbey*, which plied from Neath to Bristol, a distance of upwards of sixty miles, and which had only two 12-inch cylinders—in fact, a mere toy—of course, using high steam. Now, she could walk round the *Beresford*, which had two 40 horse-power engines:—the working her upon the high-pressure steam principle necessarily increased the speed of the piston. With these engines they had stepped out of the old track. They had not adopted the American plan of a high-pressure engine and puffing off the steam, but of a high-pressure engine without puffing off the steam and without using a jet of cold water. He confessed that when this plan was proposed by his younger coadjutors, he, as one of the old-fashioned, hesitated—but at length he consented. The *Neath Abbey* had a screw propeller with three blades, which were immersed under the water—her propeller being about 3½ feet in diameter. The vessel is built in the best form, allowing sufficient breadth for her engines. The two 12-inch cylinders are placed diagonally, and slung up by wrought iron beams; and they lay hold of one crank pin like the hands of two men working at a grindstone; and thus they conducted their engines almost in a snuff-box. Then they employed their boiler in the manner described by Mr. Russell. Then they came to the condensation of the steam, which they did not allow to go puffing off, but let it pass back into the boiler condensed, and in a distilled state, which accounted for their never having any mud or dirt in their boilers.

[* The tone of self-and-society appropriation and glorification, predominant throughout this article, is extremely reprehensible. More than the better half of it has no foundation in truth. We need but give one striking instance:—Mr. Russell claims the placing of the "greatest width of water line (the beam) two-fifths from the stern and three-fifths from the bow," as an improvement made by the British Association, under the inspection and direction of Mr. John Scott Russell. Now, this improvement is as old, at least, as the experiments of Col. Beaufoy in the Greenland Dock (of which, *not* strange to say, Mr. Russell never once makes mention). See *Mech. Mag.*, vol. xxiv., p. 380.—Ed. M. M.]

THE GRESHAM PROFESSORSHIP OF GEOMETRY.

The article in the *Athenæum* which we transferred to our columns the week before last, and which was founded on the series of papers which had previously appeared in this Journal on the subject of the Gresham College, has called forth the following defence of the Gresham Trustees.

The tone of the article on this subject in the *Athenæum* is unjust towards the present Trustees as to the motives that appear to have guided them in their choice of Mr.

Edkins:—nor are the facts relating to it correctly or fairly stated.

The Trustees have not, as is alleged, considered the appointment as "the private patronage of a few illiterate liverymen;" neither is it true that Mr. Edkins is the son of a common-councilman. A relative of his has, indeed, been chosen a member of that body—subsequently, however, to Mr. Edkins having been selected, by the joint act of the professors of University and King's Colleges, from a number of highly recommended candidates, as the Second Master of the City of London School. At that time no member of his family had any connection with the Corporation. His zeal, assiduity, and success at the head of the mathematical department in this large and important Institution have guided the trustess, most of whom have taken a part in the management of the school, in the choice they have made—and not, it is presumed, unfairly or unreasonably, although in so doing they have preferred a resident layman, wholly devoted to scientific pursuits, to his distinguished clerical competitors, and a most successful teacher to the son of an alderman. So much for this invidious imputation on the motives of the Gresham Committee. The members of the Committee may surely be justified in accepting as a satisfactory guarantee for the propriety of conferring upon Mr. Edkins the office of teaching geometry in Gresham College the remarkable success in mathematical studies of every one of his pupils who have proceeded to the universities, and the opinions repeatedly expressed by the examiners of the school, men of high reputation as mathematicians. What he may do in his professorship remains to be seen; the Trustees, from past experience have good reason to expect that he will be anxious to make it conducive to the advancement of the science to which he has been devoted.

The article concludes with a denunciation against the Corporation: "The Corporation of London is strong—but there cometh a stronger!" Is there, then, to be more spoliation?—Is it not enough that the corrupt ministers and Parliament of the Third George plundered Gresham College of its revenues, so that only 500*l*. a year are paid by Government for Gresham Estates which would now let for 5,000*l*., leaving what more is requisite to be defrayed by the Corporation and the Mercers' Company? If, therefore, "there cometh a stronger" to seize on the trust, the greater part of the funds which should have supported the College will be found to have been applied by Government to the Excise-office; and the new College has been built and is supported, not with the funds of the trust, but with those of the two corporate bodies to whom Gresham confided it.

CANDIDUS.

August 10, 1848.

The defence of "Candidus" is thus ably and satisfactorily disposed of by our contemporary:

*** The Gresham case has so very bad a look that many persons might suspect our account to have been distorted or coloured. We are, therefore, well pleased to see the other side: and we can assure our readers that the name of our correspondent, if we were at liberty to give it, would be a guarantee for the above answer being the best that could have been given.

We will consider, then, the various points of our correspondent's letter. First, we are stated to have alleged that the Trustees "considered" the appointment as private patronage. We merely said that they had *made it so:* we never doubted that they would have good words in their mouths about the duties of their trust. Next it appears that Mr. Edkins is not the *son* of a common-councilman—but some other relative. Our correspondent further states that this gentleman has been preferred to the son of an alderman:—we were aware that he was preferred to the son of Alderman Gibbs. Throwing such matters as these aside, the long and short of our correspondent's argument is, that Mr. Edkins has made a good teacher of such elements of mathematics as are learnt in a boys' school. This is the last kick at poor Gresham College! That the chair founded for the advancement of learning among educated men, and filled in their time by Briggs and Wren, should be considered as worthily occupied by a person who has given no proof, either in his college degree or in his subsequent career, of having ever attended to the higher branches of his subject, because he has been a good teacher in a boys' school—is the finish! It is true that there are, and have been, teachers in schools who have made themselves known by the fruits of their leisure; but we have yet to learn that Mr. Edkins is one of those.

In his grasp at every twig, our correspondent has laid some stress upon the fact of a layman being preferred to clerical opponents. Now, first, Mr. Potts, the most *geometrical* of the rejected candidates for this chair, is a layman; and Mr. Moseley and Mr. Cowie, though clergymen, have not cure of souls, but are connected with education, as Mr. Edkins is—Mr. Moseley being an inspector of schools, and Mr. Cowie the head of the College of Engineers. Our correspondent has volunteered the information that Mr.

Edkins is "wholly devoted to scientific pursuits."—What has he done?

As to the question about spoliation, our correspondent is altogether wrong. When we hint at a power which shall prevent the Gresham appointments from being private patronage, he asks if there shall be more spoliation? We answer, yes, if by spoliation be meant restoring the College to its pristine state and intended use, in so far as its remaining funds will serve that purpose. We disapprove of the "plunder;"—but we are quite sure that neither ministers nor Parliament would have dared to touch the Gresham fund if the Corporation had kept the College in activity. A highwayman who stops a runaway clerk, and makes him give up the assets with which he is taking himself off to America, is a robber:—but we do not feel so much concerned at the clerk's loss as we do at that of his master.

We have taken the liberty of striking out a parenthesis in our correspondent's letter, wherein he alludes, by name, to a gentleman whom he alleges to have recommended Mr. Edkins to his post in the City of London School. We do not desire to give occasion to further correspondence. Possibly the gentleman so alluded to might write to inform us that he considered the second mastership of a school and the Gresham professorship two very distinct things.

ON THE COLOURED PHOTOGRAPHIC IMAGE OF THE SOLAR SPECTRUM. BY MR. EDMOND BECQUEREL.

The author, in the course of his researches upon the chemical action of light, was led to this remarkable fact, that the solar spectrum could form its image with colours corresponding to its own, upon a plate of silver properly prepared. For this purpose the plate may be attacked by free chlorine, with the precautions indicated in the note presented to the Academy: the sensitive coating which is formed upon the surface of the plate, is red in the prismatic red, yellow in the yellow, green in the green, blue in the blue, and violet in the violet. The reddish tint turns to purple in the extreme red, and extends even beyond Fraünhofer's line A; as to the violet, it continues far beyond A, gradually becoming more feeble. When the action of the spectrum is permitted to last a long time, the tints become dark, and the image finally takes the metallic lustre; the colours have then disappeared.

According to the preparation of the plate and the thickness of the sensitive coating, any of the tints of the spectrum may be made to predominate; thus, a surface well prepared, and previously in diffused light coloured purple under a deep red glass, gives a beautiful coloured photographic image of the spectrum, in which the orange, yellow, the green, and the blue, are marked with the greatest clearness. The substance formed upon the surface of the silver is not the white chloride, but probably a subchloride, since it is not strongly coloured beyond the visible violet, as the chemically precipitated chloride is, and the maximum of action is found in the yellow, where the maximum of luminous intensity is, or moves towards the red, according to the preparation to the plate. To get a tolerably rapid action, it is necessary to use a strongly concentrated spectrum. These effects explain the red colour of the chloride of silver, and of the sensitive paper formed with that compound, in the red rays, which has been already observed by MM. Seebeck and Herschel.

The author has succeeded in preparing, by means of free chlorine, and also by using bichloride of copper, a sensitive coating of the chloride of silver, so impressed that now only certain parts of the spectrum are represented with their colours, but besides, white light makes a white impression.

The compound formed upon the surface of the silver, by the action of chlorine, is the only one hitherto found which shows the properties here mentioned. Up to the present time, it appears necessary to keep the coloured prismatic images in the dark, and the author has not found the means of fixing it under the influence of light. If the fixation could be accomplished, and if the sensitiveness of the material was greater, we could not only draw, but also paint by light; nevertheless, the results mentioned, show that the solution of the problem is possible.

QUESTION IN DYNAMICS.

Sir,—Some of your distinguished mathematical contributors will perhaps be good enough to answer the following:

Can there be any motion in the universe which imparts motion without losing the motion it imparted?

If a jet of water impinge into the cavities of a wheel receding from the jet at half its velocity, the water will have lost all its motion, and will fall with no other motion than that due to its gravity.

What motion will the water have left when the jet moves a wheel by reaction, or more properly unbalanced pressure, at half the velocity of the issue?

If a jet of unbalanced pressure issuing at 32 feet per second into the atmosphere pro-

pel a vessel in the opposite direction at 16 feet per second, (assuming it can do so,) at what distance from the orifice must a trough be placed to catch the water *without impygement?* At what distance also must the end of the trough be to prevent the water impinging *when it falls*, if it then have any motion in it? The projection of the jet is twice the square root of the altitude due to the velocity of the issue multiplied by the height of the orifice above the horizontal plane. Will it, then, be according to the altitude due to the whole, or differential velocity?

If a stone be thrown from a railway train at 32 feet per second, the train going at 16 feet per second, how long must the train be for the thrower to catch the stone?

A. B.

August 22, 1848.

[We insert these questions out of regard to an old and (by another signature) universally esteemed correspondent, and because we know that interests of considerable magnitude are dependent on the practical solution; we hope also that some of our mathematical friends will not disdain to bestow a little of their attention upon them; but, at the same time, we must beg that it may not be inferred from our insertion of them, that we are either blind to their paradoxical character, or at all inclined to the conclusions apparently aimed at by their proposer.—Ed. M. M.]

THE GIANTS OF OTHER DAYS.

In a recent lecture, Professor Silliman, the younger, alluded to the discovery of the skeleton of an enormous lizard, measuring upwards of 80 feet. As no living specimen of such gigantic magnitude has been found, the professor argued that the species of which it is the representative must have greatly degenerated; and the truth of this position he endeavoured to enforce by an allusion to the well-known existence of human giants in the olden times. The professor cited the following instances:—"A giant was exhibited at Rouen, in 1336, which," the professor says, "measured over 18 feet. Gorapius saw a girl who was 10 feet high. The body of Grostes was 11½ feet high. The giant Galbara, brought from Arabia to Rome, under Claudius Cæsar, was near 10 feet high. Funnman, who lived in the time of Eugene II., measured 11½ feet. Scrog, in his voyage to the Peak of Teneriffe, found in one of the caverns of that mountain, the head of Gnuuch, which had 80 teeth, and it is supposed that his body was not less than 15 feet long. The giant Ferragus, slain by Orlando, nephew to Charlemagne, was 18 feet high. In 1814, near St. Germain, was found the tomb of the giant Isorent, who was no less than 20 feet high. In 1590, near Rouen, was found a skeleton whose skull held a bushel of corn, and whose body must have been 18 feet long. Platorious saw, at Lucerne, the human bones of a subject 19 feet long. The giant Bacart was 22½ feet high; his thigh bones were found in 1703, near the banks of the river Moderi. In 1613, near a castle in Dauphigny, a tomb was found 30 feet long, 20 wide, and 8 feet high, on which was cut on a gray stone, the words "Keutolochus Rex.' The skeleton was found entire, 25¼ feet long, 10 feet across the shoulders, and 5 feet deep from the breast bone to the back. Near Mazarino, in Sicily, in 1516, was found the skeleton of a giant 30 feet high. His head was the size of a hogshead, and each of his teeth weighed 5 ounces. Near Palermo, in Sicily, in 1548, was found the skeleton of a giant 30 feet long, and in 1550, another 33 feet high"!!!

[We are rather surprised that the learned *Silli*-man, the *younger*, did not go on to mention the case of THE GIANT OF GIANTS, recorded in the Chronicles of the Lost Atalantis, who could stand with one foot on Europe and the other on America; between whose legs it took people many long months to travel; and who was wont to wreath his prodigious temples with strings of *real stars*, plucked by his giant arms from their native spheres. The "Chronicles" we allude to is rather a scarce book; but if Professor Silliman will give us a sight of a good authority for any one of his wonders, we will show him our copy, and make him a free gift of it into the bargain.—Ed. M. M.]

NOTES AND NOTICES.

Coating of Ships' Bottoms.—Portsmouth, 15th inst. The *Rocket* steam vessel, of iron construction, was docked this morning, to have her bottom examined. She was coated 12 months since, on one side of the bottom with the then newly-invented anti-corrosive composition of naphthalzed pitch, and on the other with that preparation and red led, in alternate streaks, zebra fashion, in order to develop more perceptibly the advantages of those alleged preventives of the growth and adhesion of rubbish, animalcules, &c., to the bottoms of iron-vessels. Admiral Prescott, Mr. Murray, Mr. Pincham, and numerous other officers of eminence in this establishment, made a survey of the results this afternoon, which was pronounced most satisfactory as regards the efficacy of Mr. Hay's valuable antidote. The iron, coated with that officer's preparation, was free from all the adhesive substances that usually cling to iron subject to the action of salt water, except in here and there a spot which had been imperfectly paid; whereas, the red-led streaks were covered with weeds and grass some feet long, muscles, shrimps, barnacles, and every kind of impediment to sailing, independent of the great oxidation which had taken place. [Mr. Hay is the chemical assistant to the master shipwright and lecturer upon scientific subjects to the Royal Naval College.]

Salt Water and Fresh.—We have just had the pleasure of drinking a goblet of water taken from the sea at Margate, as sparkling and aqueable as if drawn from the best pump in London: indeed, it was impossible to tell the difference. The water had been previously distilled in the usual way, and then treated by the simple galvanic process, as patented by Mr. Crosse. The invention, for emigrant ships and other long voyages, will be invaluable.—*The Emigrant.* What patent? We never heard of it before.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Thomas Richardson, of Newcastle-upon-Tyne, chemist, for improvements in the condensation of metallic fumes, and in the manufacture of white lead. August 21; six months.

William Young, of Queen-street, Cheapside, lamp manufacturer, for improvements in closing spirit and other cans or vessels. August 21; six months.

Isaac Taylor, of Stanford Rivers, Essex, gentleman, for improvements in preparing and engraving surfaces; also in the construction of cylinders adapted for engraving, and also in machinery for printing and ornamenting surfaces. August 21; six months

Richard Shaw, of Gold's-green, West Bromwich, Stafford, railway-bar finisher, for improvements in the manufacture of iron into tyre bars, round bars, square bars, and flat bars, Tee iron, angle iron, and trough iron. August 21; six months.

John Bethell, of Parliament-street, Westminster, gentleman, for improvements in preserving animal and vegetable substances, and also stone, chalk, and plaster from decay. August 21; six months.

Alexander Angus Croll, of the gas work, Tottenham, for improvements in the manufacture of gas and in apparatus to be used in transmitting gas. August 22; six months.

Hugh Lee Pattison, of Washington-house, Gateshead, Durham, chemical manufacturer, for improvements in manufacturing a certain compound or certain compounds of lead, and the application of this, and certain other compounds of lead to various useful purposes. August 22; six months.

Alonzo Buonaparte Woodcock, of Manchester, for improvements in steam engines, and in apparatus for raising, forcing and conveying water and other fluids. August 22; six months.

Alfred Vincent Newton, of Chancery-lane, Middlesex, mechanical draughtsman, for certain improvements in dressing or cleaning grain, and in separating extraneous matters therefrom. (Being a communication.) August 22; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Aug. 17	1540	Abraham Bettridge & Co.	Birmingham	Penholder.
„	1541	Richard Burrows	Ruddington, Notts	Regulating apparatus, or stop-gauge, for farming implements.
„	1542	Lynch and Inglis	Manchester	Pressure gauge.
18	1543	William Day	King William-street	Beer tap.
21	1544	Robert Weare	Birkenhead	Galvanic diffuser.
22	1545	Shaw Thewlis & Peter Griffith	Warrington	Cheese press.
„	1546	James Campbell	Beak-street, Regent-street	Champagne and aërated water-fountain tap.
„	1547	Thomas Spicer Dismore and George Dismore,	Clerkenwell-green	Waistband centre.
23	1548	William Armitage	Louth	Safety signal light.
24	1549	Samuel Messenger	Birmingham	Railway signal lamp.

CONTENTS OF THIS NUMBER.

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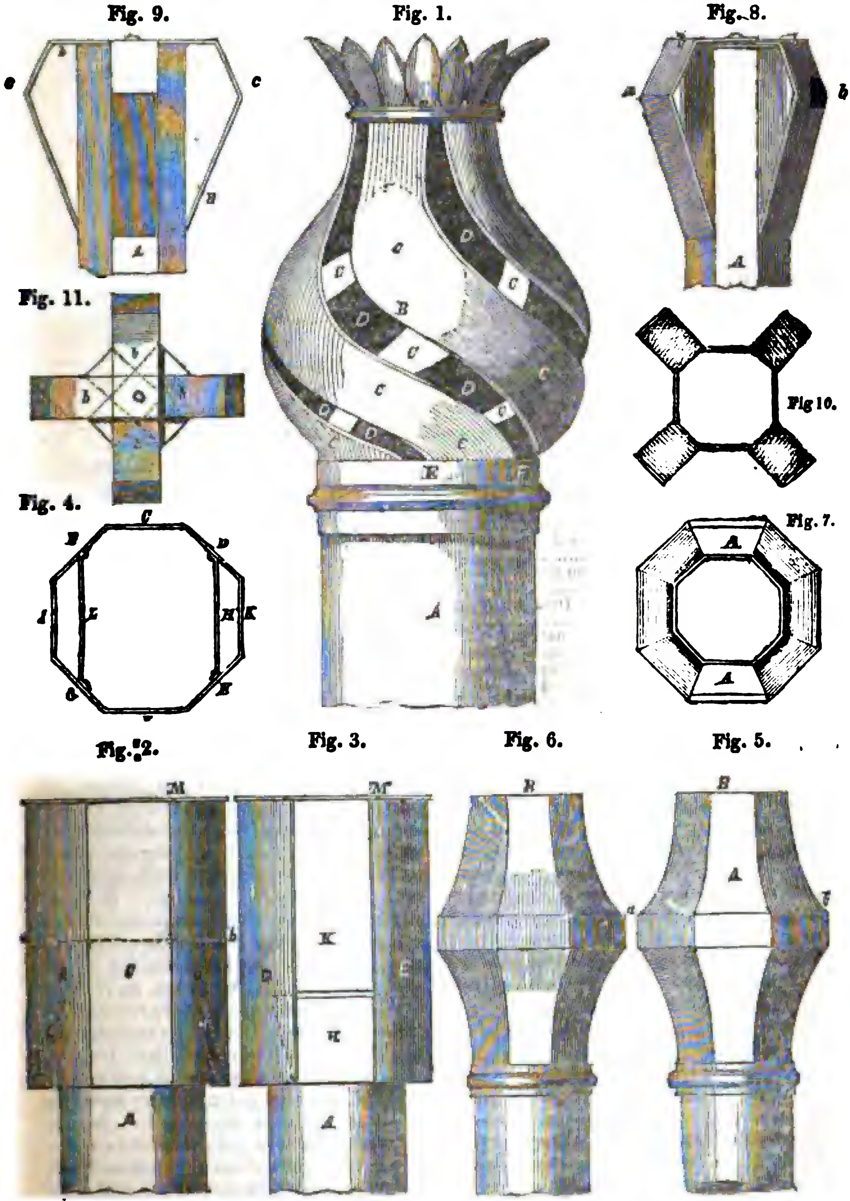
Edited by J. C. Robertson, 166, Fleet-street.

DAY'S IMPROVED WIND GUARDS.



DAY'S IMPROVED WIND GUARDS.

[Registered under the Act for the Protection of Articles of Utility. W. Jeakes, Great Russell-street, Bloomsbury, Proprietor.]

Fig. 1 is a representation of one of these improved guards. A is the stem or base; B, the body which is formed of plates, C C C, worked into a spheroidal form, having spiral openings or slots, D D D D, between them. These openings are more than double the area of that of the chimney-shaft. The plates, C C, are subsequently united by the tie pieces, *c c*, and the solid crown, F.

Fig. 2 is a front elevation, fig. 3 a side elevation, and fig. 4 a plan on the line *ab* of fig. 3 of another form of guard. A is the stem; B, C, D, E, F, G, the side plates; K and I, openings, the combined area of which is more than double that of the chimney-shaft. H and L are plates placed at an angle, to give an upward direction to the wind, and prevent its blowing down the chimney; *m* is a solid top.

Figs. 5 and 6 are side elevations, and fig. 7 is a plan in section on the line *ab* of a third design for a guard. Two of the sides, AA, are opposite each other and their combined area is more than double that of the chimney shaft. B, is the flat top.

Figs. 8 and 9 are front and side elevations. Fig. 10 a section on the line *ab*, and fig. 11 a plan of the top. A is the body; B B B B, the sides; the ends, *b b b b*, are bent inwards at right angles to assist in forming the top. The sides, CC, are shaped as shown in figs. 9 and 10, and form the openings for the wind-guard. The area of each opening is equal to that of the chimney-shaft. The ends of the sides, C C, are bent over *b b b b*, to which they are fastened, and so complete the cover.

ON THE DIFFUSION OF SOUND—MEANS OF INCREASING THE SOUND OF INSTRUMENTS.

Sir,—I have taken the liberty of addressing to you the following remarks, in the hope that they may draw the attention of some of your readers who have the leisure, which I have not, to do justice to the subject, though it may be that the questions I raise may have been already decided.

On reading the report of Professor Faraday's fifth lecture "On Chemical and Electrical Forces," at the Royal Institution, I was put in mind of some inquiries which I had formerly directed to the phenomena of acoustic telegraphing. The report recites two experiments, illustrating facts as to the transmission of sound, which are familiar to most of your readers, but to which I must refer as the groundwork of my remarks. In one experiment, a thin strip of deal was suspended from one end of the lecture-room to the other, and at the further end it bore against a box. A tuning-fork, when struck and applied to one end of the strip of wood, caused the box at the other extremity to emit a loud musical sound, though the tuning-fork itself could scarcely be heard. In the other experiment, a rod of metal passed through the floor of the lecture-room, and was placed in connection with a pianoforte in a room beneath. When the instrument was played, scarcely any sound was heard, until a guitar-case was placed on the rod, and then the notes were distinct and loud, as if proceeding from the guitar-case.

Your readers will notice that the sound heard, does not depend on the power of the instrument, or on the size of the conducting-rod; for until the latter is brought in contact with some vibratory body the sound is scarcely audible. This is familiar enough; but looking at practical results, it does not seem to me that sufficient attention is paid to the means for diffusing sound, the whole power of musical mechanics being directed to the generation rather than the diffusion of sound, and very little distinction being made between the generation, conduction, and diffusion of sound. It is at once taken for granted, and is true within certain limits, that the effect must depend upon the power originally developed; but this is the same, as if in a steam-engine it were taken for granted that the steam generated is wholly represented in the working power, and as if the one answered to the other, and it was necessary, in order to get a greater working effect, to generate more steam, before full work had been got out of the weaker engine. Musical instrument-makers have, however, applied themselves to make instruments which are more powerful gene-

rators of sound, rather than to get the greatest possible diffusion of sound from those of less power.

In connection with the experiments recited, it necessarily suggests itself that the sound heard is proportional to the surface of the box exposed, which I call the generator and dependent on its relative vibrating qualities. Whether any experiments have been made by Mr. Wheatstone and others to determine the laws which regulate the superficial area of such generators I am unaware, though experiments have been made as to the size and materials of conductors. Hitherto the investigations of mathematicians have been directed rather to the laws which regulate the vibrations of the air, than the point which I now suggest, of the laws regulating the diffusion of sound as distinct from generation.

Practically, as I have said, little or no attention is paid to the distinct laws governing diffusion of sound. In a violin, for instance, the area of diffusion, or the box of the instrument, is limited in size, though in the larger bass the greater area of diffusion, and not the larger strings, give forth a louder sound. The motives of convenience suggest the reason in this case. In a trumpet, or horn, the diffusive area is only on the mouth of the instrument, and the other parts are devoted to generation and transmission. In a piano, although the instrument may seem loud, and the power is supposed to be in the strings, the diffusion depends mainly on the sounding-board, of which the area exposed is small, the form not even being so well adapted as that of the violin to give the greatest area of diffusion. With all the mechanical appliances of the organ, the effect produced is relatively small. The harp is an instrument much restricted in its effective sonorous productions.

The necessity of uniting the generative and diffusive properties in one instrument, under the present system, governs the forms and powers of the instrument, and, consequently, the extent of sound effectively heard. The violin must be of the size not to produce the loudest sounds, but to be conveniently handled; other instruments subserve the same law of convenience. If we separate the processes of generation and diffusion, experiment, it seems to me, holds out to us the means of getting a greater effective sound. I say effective sound, to express not the quantity of sound generated, but that which is made sensible to the ear. This separation, carried out under certain conditions, holds out the means of increasing orchestral and other effects so as to produce results, which may be regarded as truly wonderful.

In considering the question of sound, it has been most usual to look at the partial effect, resulting from the direct emanation of sound from the instrument or speaker, whereas if we have a diffuser of suitable form, we may diffuse sound in every direction. Adopting Professor Faraday's second experiment, the guitar-box, if placed in the middle of the room, would diffuse sound in every direction, while a musical instrument acts only partially. Professor Faraday alludes to some points which illustrate the identity of the laws governing electricity and sound, and others have shown the identity of other laws governing light and sound; but sound likewise seems to have the property of fluids, of acting equally in every direction, and by proper attention to this property, we may produce as great an acoustic effect with musical instruments, as we do mechanically with Bramah's press.

One result, which is the consequence of separating the processes of the generation and diffusion of sound, is a greater economy of the generative power. Thus we may readily assume that a small organ placed in a separate chamber, and connected by a conductor, with a diffuser placed in a church, shall give forth a louder sound than even a larger organ in which the means of diffusion are neglected. To do this, is to place within the resources of a greater number, effects which can now be commanded only by the wealth of a few.

If these remarks meet your approval, I propose to communicate some further considerations in reference to other practical branches of the subject.

I am, Sir, yours, &c.,

HYDE CLARK.

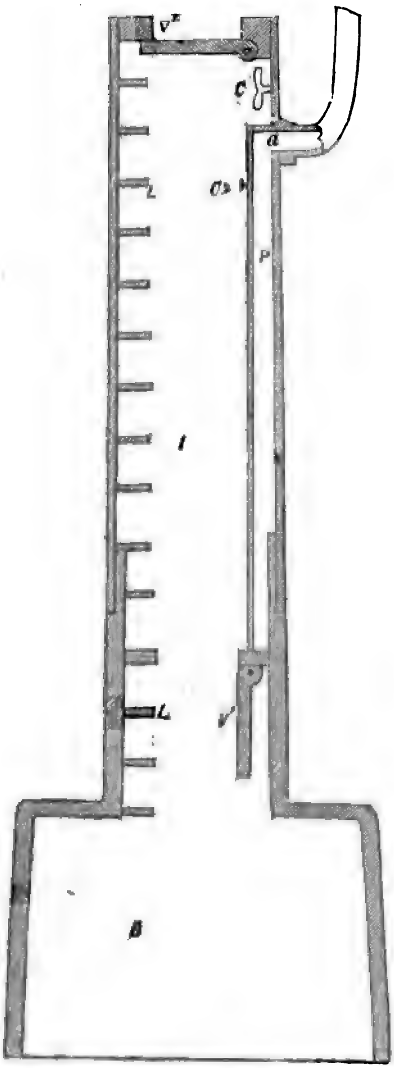
42, Basinghall-street, August 24, 1848.

IMPROVED DIVING BELL.

Sir,—As the bold experiment of building nearly perpendicular sea walls is in actual progress of execution, and as every lover of his country must be anxious for its successful accomplishment, —even those whose opinions are adverse

to it,—it behoves persons who have (to the best of their knowledge) original notions of schemes or inventions, which may possibly facilitate the great undertaking, to lay them before the public.

As the diving-bell will be in great requisition during the work in question, I conceive that any important improvement in that necessary machine would greatly facilitate it. I therefore here submit my notion of an improved diving-bell.



Perfect as the present one may appear to be, it seems to me that much loss of time and inconvenience are occasioned, by the machine having to be hoisted out of the water and lowered every time the man has to be relieved. To obviate that necessity is the basis of my improvement, which I effect by fixing an iron tube to the upper part of the bell, of sufficient internal diameter to allow of a man getting up or down in it, and of the required length for whatever depth of water it may be intended to be worked in. In this tube are two air-tight valves or trap-doors, the openings of which are large enough to admit of a man passing through them. Thus, in the annexed engraving, B is the bell; T, the exit tube; V 1, the first valve or trap-door, opening downwards; V 2, the second or upper valve, also opening downwards; LL, the ladder or steps for climbing up or down the tube. Now, supposing the bell to be at work, with the upper valve closed and the lower one open, and that a man at work in it, wants to make his exit to be relieved, he climbs up the tube, and having passed through the first opening, he carefully closes the valve, using any convenient purchase to make it perfectly air-tight. That done, he again ascends the tube until he reaches the upper valve; but this he cannot open until he turns the cock, C, to let out the condensed air, whose density will be in proportion to the depth of the bell's immersion. Any personal inconvenience from the sudden changing of the air's density, is prevented by his having the power of liberating the condensed air as gradually as he chooses; the valve would fall by its own weight a little before the internal air was in equilibrium with the external. Through the opening by which he would make his exit (if to be relieved), the other man would enter, and, after first closing carefully air-tight the upper valve, he would turn a small cock, C 2, contrived to admit the condensed air by a pipe leading into the bell, as gradually as he chose. Before the air in the tube was in equilibrium with that in the bell, he would, by unfastening the lower valve, which would fall by its own weight when relieved from the air's pressure, be enabled to enter the bell. And so, in this manner, the workmen might be relieved as often as could be desired.

Although not a diver myself, I can well fancy the confidence one would feel,

to know that he had the means of exit out of his confinement at pleasure; and those who superintend diving-bells can best appreciate the labour and time which would be saved by doing away with the necessity of hoisting the bell out of the water (especially in a heavy sea) every time the men have to be relieved.

The increased weight caused by the length of the tube when required to be worked in deep water, say 42 feet, may be urged as an objection; but this may be remedied by making a great part of the tube of wrought or sheet iron, securely riveted to the cast iron tube. The tube might be made (if desirable) to weigh, with the bell, not heavier in water than the present one, and the upper part, being the most buoyant, would have a tendency to make it keep in a perpendicular direction. Should the stroke of a sea or wave, acting upon the tube, inconveniently shake the machine, nothing would be easier, with such a length of tube, and part of it above water, than to secure the machine steadily in a perpendicular direction.

It appears to my mind, that a diving-bell of this description might be made on a much larger scale than the present one, and the work greatly facilitated by the employment of more divers. I think, also, that gas might be led down by a pipe from the upper part of the tube into the bell, so as to illuminate it sufficiently for the men to work by night as well as by day.

The sun will be, ere long, to the south of the line, and much calm and beautiful weather will happen during darkness before the sun recrosses it, for carrying on without loss of time the important work. Supposing the bell to be in use for laying the foundation, it may not be required to be moved at all for some time, and therefore would need much less night attendance than the other, whilst the submarine work would be in continual progress. The air might be pumped into the opening of the tube at *a*, and let down into the bell by the pipe, P, and the long flexible air-tube discontinued.

I have not made an external drawing of the machine, because I do not attempt to describe how it is to be manufactured, and merely send a section to show the *principle* of it, knowing well that should it be deemed worthy of adoption, first-rate engineering capacity will not be wanting, to carry out the idea in the most masterly style; so on this head I should have no misgivings.

There would be no fear of the valves not being air-tight, when one atmosphere would produce a pressure on either, of 8,640 lbs., supposing the openings to be two feet square in diameter. These valves must, of course, be made sufficiently strong for whatever pressure they might be exposed to.

I may observe that the lower valve might be placed at any convenient situation; if low down, two men might make their exit, by shutting and opening the valves only once instead of twice; but the more the valves were placed asunder, the more condensed air would be wasted every time the valves were opened and shut; however, that would be of little consequence, considering the ample supply of air.

For convenience, there might be two or three sets made, to suit different depths of water. The one intended for seven fathoms would require a tube about fifty feet long, as eight feet of it should be above water, so as not to allow any water to enter the upper opening. With such a length of tube there would be ample room for seven men to stand, one above the other, between the two trap-doors, so as to admit that number to be relieved, if required, in only one operation of opening and shutting the valves; although, as I before observed, should any inconvenience be felt from the loss of so much condensed air as would be contained in the tube between the two valves, it is quite optional the placing them at any distance from each other—not being less always than the height of one man. The sectional drawing is on a quarter-of-an-inch scale, which shows the internal dimensions of the bell to be eight feet at bottom; that seems an enormous size for what is *now* called a diving-bell; but I really see no occasion whatever for its being made of cast iron, as it requires no strength as regards internal and external pressure, which are equalized. In fact, the only use of its great weight is to sink it, which might be more conveniently managed by contrivances to load it securely with lead-pig-ballast properly fixed. Thus we should have a spacious diving machine—for I would no longer call it a bell—ca-

pacious enough to employ several workmen, with plenty of elbow-room, which should not be, when unloaded and hoisted out of the water, inconveniently heavy for transportation.

I can conceive such a submarine chamber, with plenty of thick glass to give it ample light by day and brilliant gas to light it by night, one in which divers would delight to work in, and one which would greatly facilitate the completion of that great national undertaking—the Dover Refuge Harbour. I shall conclude, with the hope that it will be found worthy of consideration by the eminent men who are carrying it out.

I am, Sir, yours, &c.,
M. S. SHULDHAM,
Commander R. N.

HUSSEY'S PORTABLE MEAT-SCREEN.

[Registered under the Act for the Protection of Articles of Utility. John Joseph Hussey, of Hertford-street, Fitzroy-square, Carpenter and Wholesale Kitchen Screen Manufacturer, Proprietor.]

Fig. 1. Fig. 2. Fig. 3.

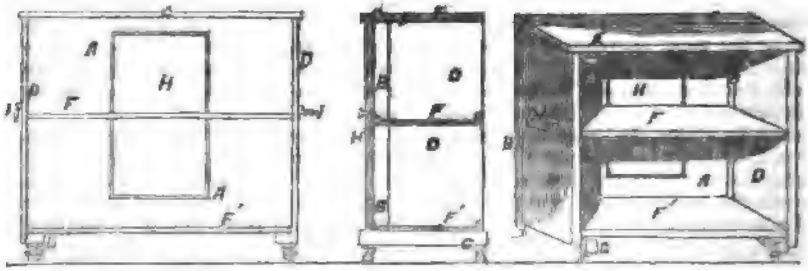


Fig. 1 is a front elevation of this screen; fig. 2 is a cross section on the line *ab* of fig. 1; and fig. 3, a perspective view. A is the back, to which the two flat side pieces, BB, and a flat top piece, C, are attached. The other portions DD of the sides, and E of the top, are hinged to the fixed pieces, BB and C. FF^1 are shelves, which are hinged to the back, A. When the article is not in use, the shelves, FF^1, can be folded up into the position represented by the dotted lines in fig. 2. The sides, DD, together with the feet, GG, which are attached to them, may then be folded in over the shelves, when the top, E, will fall down over these other parts. In this folded state the apparatus occupies very little space. And in this consists the great advantage which it possesses over ordinary meat screens. H is the door, and I I the handles.

CAPTAIN CARPENTER'S QUARTER PROPELLERS.

The series of past experiments, and those which are in daily progress, in the application of screw steam machinery to vessels of war, have fully evolved the merits of this novel power of propulsion, and established its superiority over paddle wheels. What has thus been attempted step by step, has elicited information forming data for working out *another principle* of motion, which, when perfected in its application on a large scale will, we believe, lead to results of a yet more satisfactory and important character.

The *Morning Herald* has made the following announcement, 1st July, 1848:—"The *Amphion* is the ship that has laid the foundation for that mighty success which is shadowed forth in the working of the *Encounter* sloop, the second large ship which has been tried with advantage and credit.

"In our former notices of the *Encounter* we have stated, that she was designed by Mr. Fincham, of Portsmouth dockyard. She is 895 tons, and has engines of 360 horse power, by Messrs. Penn and Co., and yesterday we spoke of the compactness of the machinery and the rate of her speed on the

passage to Portsmouth from Woolwich. This vessel is indeed a wonderful instance of what has been accomplished, in the improvement of both vessel and engines. She was tried several times on the river, with the most gratifying results. On the last trial in the river, immersed with weights equal to her stores and armament, she attained an average speed of 11 knots, the engines having cylinders 60 inches diameter, with a stroke of 2 feet 3 inches, making 78 revolutions, with a screw 12 feet 6 inches diameter, and 16 feet pitch; and this speed with another and better adapted screw, she has maintained within half a knot on a sea passage; the ship too, having comparatively for a steamer a bluff bow, as is necessary for men-of-war to possess.

"A third large ship is now about to come into the field of experiment, and this vessel is the frigate *Dauntless*. She was built by the same naval architect (Fincham), but that extreme portion of her stern in which the propeller is placed, instead of being finely shaped away as that of the *Encounter*, is square, and thus in her case it is proved beyond question that with a square truck, although with lines generally good and well adapted for a screw-steamer, she cannot attain that speed which the *Encounter* with a finer run has acquired; for although the *Dauntless* has engines of 580 horse power to 1,496 tons, or 1 to 2·58, the highest mean rate of speed on trial was not beyond 7½ knots."

Here then we have an example on a large scale—showing that the propeller, when it is working in the broken water, as it always must be in the dead-wood position, will not produce so satisfactory a result; but immediately it is removed into the more solid stream the speed of the ship increases, which applies particularly to the model about to be described, with the "*quarter propellers*."

The following letter appeared in the *Morning Herald*, 1st July, 1848:

"Sir,—An allusion having been made in your columns yesterday, under the head of 'War Steamers,' to my experiments on the lake in the Regent's Park with a variety of propellers on the screw principle, I beg to observe that they are correctly stated—namely 'Speed of model, with a propeller placed in the dead-wood, as it is applied to her Majesty's steam-yacht *Fairy*—40 feet in 21 seconds; speed with two propellers, one under each quarter, with a single vane on each propeller instead of two—40 feet in 13 seconds.'

"The plan has since been submitted to the Admiralty, and at present I am corresponding with their lordships respecting it; afterwards it is my intention to place the model in the Polytechnic Institution, that any person who takes an interest in such things may have an opportunity of seeing the experiments tried.

"The novelty of the plan consists in using two propellers, one under each quarter, with a junction to the shaft outside, where the universal joint was applied to the pinnace of the *Geyser*.

"The propellers can be detached altogether, and carried on the quarters, leaving the vessel with very little impediment to her sailing, and without cutting away the dead-wood.

"From the shafts passing outside the frame of the vessel there is more room left for the stowage of the after hold than with the dead-wood propeller.

"From the power being transmitted equally on both sides of the vessel there is less vibration.

"From there being *two* propellers, one can be used if the other gets damaged.

"From the propellers being nearer towards the centre of the vessel they are more effective in a heavy sea when she is pitching.

"From the simple arrangement of detatching and raising the propellers out of the water they are very handy for sailing ships as an auxiliary to the sails.

"With these observations I must leave the subject till the model is placed in the Polytechnic Institution.

"I am, Sir, your obedient Servant,

"E. J. CARPENTER, Captain, R. N.

"Leamington, 30th June."

The position selected for the propellers as they appear in this model, is taken from that type offered by the unerring hand of Nature, since we see the power of propulsion, there applied, in the aquatic tribe of birds of the auk species. Their boat-like form of body, mere rudimental wings, short and remote legs, scale-like plumage, all alike concurring to fit them for dwelling only on the ocean. Their velocity of movement on the surface of the waters is well known, and hitherto nothing has surpassed it.

Length of model, from figure-head to taffrail, 4 feet 8¾ inches; draught of water aft 3¼ inches; ditto forward 3 inches. Weight, with machinery on board, 23 lbs.

Diameter of propeller 2 inches.

Scale 3-8 inch to a foot.

Three shafts are placed, horizontal and parallel with each other, and connected with the machinery leading to the motive power, so that a single propeller in the dead-wood, or the "*quarter propellers*" may be worked either separately or together. A novel plan of raising the propellers out of the water, and a new adjustment of the stern bearing, are practically shown.

P.S.—The *Times*, of the 1st and 3rd September, 1838, contained a description of the propeller with two vanes, as it was originally exhibited by Mr. Taylor, one in the stern position as in the *Encounter*, the others in the quarters as in the pinnaces of the *Geyser*, before they had received motion from steam power. The *Mechanics' Magazine* contains also their faithful history long before steam gave them motion.

[The model referred to is exhibited by Mr. J. J. O. Taylor, at the Polytechnic Institution, with other models, on Mondays and Fridays, and is well deserving of the attention of all interested in the advancement of steam navigation.—Ed. M. M.]

MISS WALLACE'S PATENT IMPROVEMENTS IN THE DECORATIVE ARTS.

[Patent dated Feb. 28th, 1848. Specification enrolled Aug. 28th, 1848.]

We question much, whether the Chancery Rolls ever before presented so graceful a combination of the useful and ornamental, or were ever before made the medium of so great a movement in the constructive and decorative arts, as on the present occasion. How to enable our architects and artists to struggle successfully, against the tarnishing and corroding influences of a humid and smoke-corrupted atmosphere—how to furnish them with materials to work with, as enduring in texture as any, and more enduring in colour than all—how to give them an equivalent, and more than an equivalent, for Italian skies and Italian quarries—how to keep the purest white for ever pure, to preserve unsullied (if not "to gild") "refined gold", to shield with an invisible shield (if not "to paint") "the lily"—how to banish brick (*red symbol of democratic vulgarity!*) from the face of our architecture—how to make our palaces and houses (without costing more than they do at present) rival in external beauty of materials the finest marble structures of Athens and Rome—such are a few, of the many difficult problems in art, which Miss Wallace has undertaken to solve, and which she has solved, by means at once so simple and efficient, as quite to preclude any doubt of their rapid and universal adoption.

The chief instruments which Miss Wallace employs in her improvements, are glass and plaster of Paris; her subordinate agents, painting, enamelling, engraving, sculpture—every art, in short, that can contribute in any way to visible beauty. Our fair patentee proceeds on this general utilitarian principle, that if you can, by any arrangement or combination of materials, produce on the eye *all the effect* of any natural substance, as marble, alabaster, porphyry, &c., it is a matter of perfect indifference to the observer that the means employed are artificial. You see in this lady's studio tablets and slabs which you cannot, by looking at, distinguish from the fairest specimen of Carrara marble, and feel only much inclined to think superior to any you ever saw before. You learn, on inquiry, that they consist but of glass and plaster of Paris ingeniously put together; but why should that circumstance lessen your pleasure and satisfaction? You would not object to a gilded pillar, that it is only gilt and not solid gold: why, then, should you object to a facia, white as the driven snow, that it is only glazed plaster of Paris, and not real Carrara? You may urge that one does not expect to meet with pillars of solid gold. True; but to make matters equal in this respect, the public mind has but to be accustomed to expect, in future, never to meet with a piece of real Carrara (newly imported) on this side the Channel. The transition to such a state of feeling ought to be all the easier, that the imitation Carrara offers advantages which the real does not; the one will preserve all its original purity and freshness of colour, long after the other has sunk irredeemably into the "sere and yellow."

In the case of gold, Miss Wallace does not so much imitate, as protect the actual thing itself. The use of gilding, both for internal and external decoration, has long been universal; but if gilding is left exposed to the atmosphere (especially such an atmosphere as prevails in most of our coal and gas-burning cities and towns) it soon becomes tarnished and obscured; and hence the necessity for renewing out-of-doors gilding once a year at least, and the muffling practice within doors, so destructive of all harmony and beauty. Now, what Miss Wallace does is to inclose the gilding from the atmosphere—to give it a transparent covering—by which its lustre may not only be preserved for (almost) any length of time undimmed, but rendered more effulgent than ever. The dull projecting letter of wood or brass, gilt on the outside, she would supplant by a crystaline letter with the gilding inside; the wooden-gilt mirror and picture frame, with its sepulchral-like shroud, by a frame of glass, underlaid with irradiated gold. Assuredly, this is a very happy thought—a real and most useful invention.

However, it would be hardly correct to say that Miss Wallace protects gold only, and does not imitate it; for, as we proceed in the perusal of her specification, we are reminded, that she has also invented a mode of giving to glass all the appearance of gold, without *a particle of gold or any yellow metal being employed for the purpose;* another singular and most valuable discovery. Some specimens of this golden glass which we have seen were quite bewildering for their likeness to the actual metal; one especially, which exhibited (the semblance of) a ground of burnished gold, veiled by a network of matted or frosted gold.

Other novelties, not a few, there are in Miss Wallace's specification, which offer tempting subjects for remark; but for the present we must content ourselves with referring to the specification itself, which we have now the pleasure of laying at length before our readers.

Specification.

My invention has, *firstly*, for its object the facing of the walls, porches, pillars, pilasters, and other external parts of houses and other buildings with a combination of materials which is less liable to be affected by wet, damp, and atmospheric impurities than any material, or combination of materials, hitherto in use for the purpose, is of a beautiful lustre and great durability, and may be made to exhibit, externally, any colour, or mixture of colours, or disposition of colours, arbitrary or natural; and also to resemble closely any natural building material; as, for example, pure white marble, veined marble, shell marble, porphyry, malachite, granite, &c. I make this new facing in tablets or pieces, of any required form, as round or square, flat or curved, and of any sizes convenient for use. The materials of which it is composed are; first, an outer sheet of glass, the under side of which is either left blank or painted and figured in manner hereinafter mentioned; and, second, a backing of plaster of Paris of from half an inch to an inch in thickness. If it is intended that the facing should have an uniform, white appearance, I make use of white glass, either clear or ground; but if polished white marble, such as the Carrara, is meant to be imitated, I use clear white glass only. If, again, a substance is to be imitated, in which white is the predominant colour or ground, as in many veined marbles and in shell marbles, I use also clear white glass. But if a substance is to be imitated, in which the predominant colour or ground is other than white, as, for example, the yellow in Sienna marble, the purple in porphyry, or the green in malachite, I impart a corresponding colour to the plaster of Paris, by preparing it with water, and dissolving in the water some colouring matter or matters, soluble in water, which will produce the required colour. The lines, strokes, dots, and other markings necessary to produce, in conjunction with a white, yellow, or other ground colour, the resemblance of veined marble, shell marble, or other natural substance, are painted on the under side of the glass by any of the well-known methods of doing so, (as to which, in themselves, I make no claim,) and they may be either burnt in in the usual way, or left to the protection of the glass and plaster of Paris backing, which will in general be found amply sufficient for the purpose. The glass must in every case be well annealed, but need not be of greater thickness than ordinary crown glass, unless in the case of very large single tablets, for which thick plate glass is preferable to any other sort of glass. The plaster of Paris is laid on in a liquid state, and care taken to spread it evenly over the glass. Each tablet as finished is placed in the open air or in a warm chamber to dry, and when quite dry the glass is gently raised from the plaster of Paris by inserting a flat knife or blade between them, wiped clean, and then restored

to its place above the plaster. When plaster of Paris has been once thoroughly dried, it possesses, as is well known, the property of being no longer liable to any material expansion or contraction from variations of temperature. To protect the tablets from the intrusion of moisture at the edges, I coat these edges all over with white lead paint. In finally proceeding to fix them in their places, I first give the surface to be faced a thick coating of any good white cement, and while this cement is yet in a moist and plastic state I lay or imbed the tablets in it. And for greater security, I drive into the wall, at suitable places in the joinings, narrow copper nails with broad heads, which overlap and hold fast the tablets. For example, supposing the tablets are of a square form, one such nail inserted at each point where four corners meet would overlap with its broad head the corners of four tablets, and every tablet would have four such holdfasts. The heads of the nails might also be covered with dead white glass, (after the manner of glass buttons,) so as to be hardly distinguishable from the general surface of the wall.

Secondly, my invention has for its object the facing of the walls, ceilings and other parts of the interior of houses and other buildings, with tablets, similar to those last described, and differing chiefly from them in the greater variety and splendour of embellishment which the application of them in such places and situations, admits of with propriety. For example, the tablets may be made to represent marble, porphyry, or any of the other natural building materials beforementioned; or they may exhibit representations (that is, either on the under surface of the glass, or on the surface of the plaster of Paris,) of all sorts of objects, natural and artificial, as flowers, fruit, foliage, birds, landscapes, human figures, coats of arms, crests, &c., which representations may be either plain or coloured, or gilt, or silvered, and may be either drawn or painted on the glass by the hand of the first designer or artist, or by a copyist, or be transferred to the glass from engraved surfaces, or printed impressions of engraved surfaces, or be first drawn or painted, or printed, or stamped, or embossed on, or cut out of, paper or other suitable material, in which last case, the paper or other material must be made fast by gum or some other adhesive substance to the plaster after it has been thoroughly dried and the glass raised from it as before explained. So also, there may be imbedded in the plaster of Paris, and covered over by the glass, pieces of sculpture in intaglio or basso-relievo, or imitations in glass, or other artificial compositions, of the diamond, ruby, emerald and other precious stones, placed or grouped in any desired order, or lenses (with their plane faces uppermost,) possessed either of magnifying or diminishing properties, and with pictures or statuary placed behind them. Again, the major part of a wall or ceiling, or compartment of a wall or ceiling, may be covered with plain tablets, representing one or other of the natural building materials aforesaid, and the centres, or corners, or borders, or parts of the borders only, be filled in with tablets of the pictorial character just exemplified. Sometimes in order to enhance the effect of such pictorial tablets (as where very strong lights are required), I silver the front glass plates, protect the silvering with silver paper, and interpose between the paper and the plaster of Paris a sheet of white glass. And so also to increase the brilliancy of artificial gems when embedded as aforesaid, in the plaster of Paris, I occasionally underlay them with tin foil. The colours used in painting or drawing on the under side of the glass, should be of the description commonly used in glass painting, and known by the name of "enamel colours," which will not be affected by any damp which may exude from the plaster backing in the course of drying. But when an engraved print or drawing is to be introduced into the tablet, or the picture is to be of any material which, like paper, would be liable to be affected by damp, I proceed in the making up of the tablets in the following order:—I first pour the plaster of Paris over the glass to the required depth, and when it has become perfectly dry, I raise the glass from it, in manner before described. I then gum the print or other pictured material on to the plaster, restore the glass to its place, press it closely down upon the plaster, and finally coat the edges with white lead paint. The imbedding of the sculptures, artificial gems, lenses, and other objects is effected in this way:—I attach them slightly to the under side of the glass, in the positions they are intended to occupy, by means of small patches of plaster (turning the glass over for the purpose); I then form round the glass an edging or moulding of wood or putty, and pour gently into the enclosed space the plaster in a liquid state, so that it may diffuse itself over and around the sculptures, gems, lenses, &c., without disturbing them; and when the plaster has set sufficiently to bear lifting, I remove the moulding, raise the glass, as in the preceding instance, from the plaster, and wipe clean the sculptures, gems, lenses, &c., from any adhering plaster or moisture, replace the glass, press it closely down on the surface of the plaster, and conclude by coating the edges as before, with white lead paint.

Tablets of any of the varieties described under this head of my specification, may be fixed in their places in the same way as the tablets for the outsides of houses have before been directed to be secured.

Thirdly, my invention consists in employing, to face the walls and other flat parts of the interior of buildings, a combination of materials which exhibits externally all the appearance of figured gold, though there is neither any gold nor yellow metal employed in the same, and the surface of which combination is of a lustre which neither air nor damp can permanently tarnish, and which can never at any time want more than wiping clean, to be as fresh and resplendent as at first. To make a flat tablet of this description, I take a plate of figured yellow glass (the nearer the colour of gold the better); to the back of this I attach a plate of plain yellow glass silvered; and I unite the two plates of glass by cementing them at the edges with gutta percha, or any other suitable cement. The result of the combination is, that the figured parts of the upper glass exhibit the appearance of deadened or frosted gold, with a groundwork of burnished gold, or *vice versâ*. Sometimes I substitute for the front plate of figured yellow glass, a plate of white glass, figured or ground (the whole of it, or parts only); and sometimes I also dispense with the second sheet of glass altogether, and apply the silvering at once to the back of the figured or ground front plate.

The effect is best when the figuring of the glass has been effected by cutting, instead of by the more common fluoric acid process. Instead of using, in the formation of these tablets, such figured glass as is to be ordinarily met with in the market, the glass may be specially figured for the purpose, and have any sort of subject, design, or pattern drawn or painted on the under side of it, and burnt in also if required, as has been before described under the first head of this specification.

The fixing of the tablets in their places may be effected either by setting them in cement (with a sheet of silver paper interposed between the silvering of the under plate and the cement), or by means of metal pins soldered to small patches of lead, attached by the process called "quicking," to the back of the under plate, in places scraped clean of the silvering for the purpose, and inserted into the laths of the wall or roof. The joinings may be concealed by overlaying them with narrow mouldings of glass, inlaid with gold paper, in the manner next described, and which mouldings may be readily made fast to the surface glass by gutta percha solution.

Fourthly, to form pilasters, architraves, cornices, mouldings, beadings, and other projecting architectural ornaments with a golden appearance, equal, if not superior, to that of the double yellow glass tablet before described, I proceed as follows: I first make a mould of the ornament in wood; I then give this mould to a founder, who makes a reverse mould from it in metal, either in one piece or several pieces, as practical convenience may determine; I then hand this metal mould to the glass-blower, who takes hollow casts from it in white glass, in the same way as he now forms bottles and other hollow wares, that is to say, by blowing the glass into the mould; after which these casts are annealed and fire polished in the usual way. I next insert into each cast, a strip of gilt paper of a width sufficient to cover all the front or projecting parts of the cast, (drawing it through by means of a long needle and thread,) and back up this paper, so as to press it as much as may be, into close contact with the glass, by means of cotton wadding; and this done, I close up the ends of the cast with gutta percha solution or some other like air and waterproof cement. The gilt paper may be either plain or figured, and in all cases paper gilt with the true gold leaf (not Dutch leaf) should be preferred. Being shut up from contact with the atmosphere, this paper will retain for an indefinite length of time its original freshness and brilliancy of appearance. In fixing these ornaments in the places for which they are destined, I place them with the back or flat side undermost, and make them fast by means of gutta percha solution, marine glue, or any other suitable cement.

Fifthly, my invention consists in the occasional substitution for the imitation gold tablets and ornaments last hereinbefore described of tablets and ornaments made to resemble silver, which I accomplish in manner following:—To form flat tablets of this silver-like description, I first coat one side of a plate of glass with black lead, and precipitate on this a thin coating of silver by the electric process or magneto-electric process; I then cover this silver-plated surface with a sheet of white glass, (preferring the whitest and clearest I can obtain;) and finally connect the two plates by cementing them together at the edges with some transparent cement, as gum copal or Riga balsam. Or, instead of silvering the top surface of the under plate, I interpose between the two plates a sheet of silvered paper, either plain or embossed, and in either case well burnished. To form projecting architectural ornaments of this silver-like description, I adopt precisely the same plan as in the case

of the imitation gold ornaments of that class, substituting only silvered for gilt paper.

Sixthly, my invention consists in the employment of the following means of rendering stained, or painted, or other figured glass, when introduced into the windows, doors, domes, fanlights, and other parts of houses and other buildings, more effective on both sides than hitherto, and in the application of the same means to the formation of wall tablets and architectural ornaments, similar to those described under the preceding heads of this Specification. And, first, as regards stained, or painted, or other figured glass—I take a sheet of plain white glass, give it a coating of gum, then sprinkle over it a quantity of what are known in the glass trade by the name of "frostings," which are readily laid hold of by the gum; and the glass thus prepared I attach to the stained, or painted, or other figured glass on the inside, or that side which is next to the interior of the house or building, by means of gutta percha solution, or some other suitable cement, applied to the edges. The frostings have on the inside the effect of giving a beautiful lustre to all the lighter parts of the design on the stained, or painted, or other figured glass, without impairing in the least the strength of tone of the darker or coloured portions; while they impart to the glass, when viewed from the outside, much the same effect, as if a flood of light were streaming through from within. In the case of wall and other flat tablets, where transparency is not required, or where, at least, an effect on one side only is required to be produced, I apply these frostings to the under plates of the tablets wherever such plates have been before directed to be silvered, (dispensing, of course, with the silvering,) but with this difference, that the frostings are applied to the front instead of the back of the under plates. Or the gumming of frostings to the under plate may be altogether dispensed with by leaving a free space between the two glasses, and filling it up with loose frostings. To inlay a hollow glass architectural ornament, such as before described, with these frostings, I either fill it completely with the frostings, (in lieu of the gilt or silver paper and wadding,) or I coat it on the inside with gum, (by pouring a quantity of the gum solution through it,) and then throw in a quantity of frostings sufficient to cover the inner superficies, and attach them to the gum by shaking or whirling.

Seventhly, my invention consists in the employment of tablets of any of the varieties before described, or formed of a combination of any two or more of the said varieties, or of parts of any two or more thereof, as mural monuments in cathedrals, churches, civic halls, and other public buildings, and also in the construction of isolated monumental edifices in churchyards, cemeteries, and other places. In figs. 1, 2, 3, 4, I have given such exemplifications of this part of my invention as will make sufficiently clear the manner of carrying out the same. Fig. 1 is a front elevation of a mural monument suitable for the interior of a cathedral or church, and fig. 2 a vertical section thereof. The parts marked A, A, A, A, are composed of marble or common stone; B is an emblematic tablet, which is formed in the way hereinbefore described, of a front plate of glass, *a*, and a backing, *b*, of plaster of Paris, and let into a recess made in the upper part of the monument (see fig. 2.) The figure of a crested urn, B, is painted on the under side of the glass, and the imitation star, D, consists of a plano-concave piece of white glass imbedded in the plaster of Paris with the flat side uppermost, and underlayed with tinfoil. E is the inscription tablet, which is formed and let into a recess in the basement of the monument, in the same way as the upper tablet, and has the words and figures of the inscription painted on the under side of the upper glass plate. Fig. 3 is a front elevation, and fig. 4 a vertical section of a sepulchral edifice, which differs only from the preceding in being isolated from any other building, and in the character of the funereal emblems painted on the upper tablet, B.* The advantage of forming monuments in this way is, that the principal, or emblematic and inscriptive portions, will always stand prominently out from the other or subordinate parts, and may be expected to retain all their original freshness and beauty long after the other parts have become tarnished and decayed. Such monuments, too, though they may be made to equal in appearance the most finely sculptured marbles, will, in no case, cost nearly so much.

Eighthly, my invention consists in the application of the principles of construction hereinbefore developed to the improvement of the letters, numerals, and devices used in the figuring, designating, and decorating of houses and other buildings.

1. To make a raised letter or numeral on the same plan as the projecting architectural ornaments before described, which shall have all the appearance of a highly gilt letter or numeral, but without any of the gilding being exposed to the action of the

[* These additional figures we do not think it necessary to give.—Ed. M. M.]

atmosphere, I proceed as follows:—I take pieces of half round or semicircular tubing, drawn or cast in moulds, in the manner before described, and cut the same into lengths suitable for forming into letters or numerals, making them either square or bevelled at the ends, according to the positions they are intended to occupy. The letter ${}_{1}\mathrm{A}_{2}\,{}_{3}$ for example, would be formed of three pieces (Nos. 1, 2, 3,) all of which would be bevelled at both ends, while the letter ${}_{1}\overset{2}{\mathrm{E}}_{4}\,{}_{3}$ would consist of four pieces (Nos. 1, 2, 3, 4,)

Fig. 1.

Fig. 2.

of which No. 1 would be cut perfectly square, and Nos. 2, 3, 4 would be square at the outer ends, but bevelled at the opposite ends, so as to overlap No. 1 (the perpendicular style being supposed to be adopted in both cases). Into each piece I insert a strip of gilt paper, of width sufficient to cover the front or round part of the tube, and press it up into close contact with the glass, by means of cotton wadding, as before explained. I then close up each end with plastic gutta percha or putty. The pieces of which each

letter or numeral is composed are next put together with the flat sides undermost, upon a foundation plate of zinc or tin, cut into the exact form of the letter or numeral, and secured thereto by gutta percha solution, or some other suitable cement.

The letter or numeral is ultimately attached to the facia or other part of the house or building which it is to occupy, by means of metal pins soldered to the back or metal foundation plate, or passed through ears—two, three, or more—formed on the edges of that plate. Or, instead of thus making up the pieces into entire letters or numerals, and then fixing these letters or numerals in their places by the means aforesaid, I proceed as follows:—I quick each separate piece at the back in one or two places, of just sufficient size to enable me to solder a metal pin or pins thereto, and I attach the pieces at once to the facia or other show-place (without the intervention of any foundation plate,) securing each piece in its proper place by its own pin or pins.

I have assumed, in the preceding description, that all the parts of each letter and numeral are and may be readily formed out of straight glass tubing; but it remains that I should explain how the parts corresponding to the curved parts in letters and numerals of the ordinary character are produced. I make up these parts of short and straight pieces, cut, bevelled, and arranged so as to approximate sufficiently in general appearance to the required curves. No doubt glass tubing can be curved, but as there are some practical difficulties in the way, I prefer the mode of adapting straight tubing to curvilinear purposes, which has just been described, but without excluding myself from the use of curved tubing when I choose to resort to it.

2. To make a raised letter or numeral, which like the preceding shall have the material whereby the gilding, or appearance of gilding is produced, applied beneath the outer surface, but possess greater prominence, transparency, and refractive power: I make the parts of which each letter, or numeral, is composed out of thick pieces of white glass of a triangular form, in one side of each of which pieces hollow spaces are left in the process of moulding of any required shape; as, for example, there may be one long groove running down the centre, or two sets of grooves crossing one another angularly, or a row of circular or oval hollows; and these pieces are cut and polished in the same way as drop pinchers are accustomed to cut and polish the drops of chandeliers, after which all the hollow parts are gilt by the usual process of gilding. Or, instead of white glass, yellow glass may be used and the whole silvered, or quicked, instead of gilt. The pieces of which each letter or numeral is composed, are put together on a foundation plate of well planished zinc or tin, with the side undermost on which the hollow spaces are, and they are made fast by means of metal pins soldered to patches of quicking, formed in manner before explained, on the hollowed side, passed through corresponding holes in the foundation plate, and secured on the opposite side by nuts. The parts of the letters and numerals corresponding to the curves in ordinary letters and numerals are compounded of short straight pieces, in the same way as has been explained in the preceding section of this branch of my specification. The entire letter or numeral is affixed to the facia or other show-place by means of copper gilt pins passed through ears, two, three, or more, formed on the edges of its foundation plate. Letters and numerals formed in this way have a very radiant and striking effect. The gilt or silvered hollow spaces on the undermost side are repeated to the eye on the two other sides, producing the same effect as if each of the sides was separately gilt or silvered.

It is obvious that letters might be formed, in the same way, of pieces of glass, of a quadrilateral or any other parallelogramic form; but as none of these forms offer the same advantages as the triangular or prismoidal, I do not recommend them.

3. To form raised, but flat letters and numerals, having, like the wall tablets, described under the third head of this specification, all the appearance of gold without any gold or yellow metal being used in their formation, and much more capable than gold itself of resisting the action of the atmosphere, I proceed as follows:—I procure from the glass-manufacturer some plates of yellow glass, divided by double lines into rectangular compartments, of the width of the intended letters or numerals, the interior of which compartments may be either plain or figured, according to the character of letter or figure I am desirous of producing. I then cut these plates into straight strips by running a diamond between the double lines, by which they are divided into compartments, so that each strip as cut off remains with an edging or bordering on each side. I next cross-cut these strips into the different lengths required for the straight parts of the letters and numerals: the curved parts I cut in entire pieces out of small pieces of similarly coloured glass, supplying the edging or

bordering by cutting the same upon the underside of each piece. I now match each of these straight and curved pieces with a piece of plain yellow glass, silvered or quicked at the back, cut out of a sheet of such glass, and matched by superposition. And, finally, I put the pieces of which each letter or numeral is composed together upon a foundation plate of zinc or tin, of the exact form of the letter or numeral, but exceeding it in width to an extent equal to the thickness of the two plates of glass; that is to say, I first lay the silvered pieces on the foundation plate, I then superimpose upon the silvered pieces the corresponding pieces of unsilvered yellow glass (plain or figured, as the case may be), and unite the three pieces together by coating the edges of the glass plates with a solution of gutta percha, turning up the sides of the foundation plate, and pressing them up close against the edges of the glass. Instead of both of the plates being yellow, the under one only may be yellow, and the upper one figured white glass; in which case the appearance produced is that of burnished and matted gold. And, further, instead of two plates of glass, one only may be used, and that of a yellow colour, silvered or quicked at the back, and attached to a foundation plate as before explained; but such single glass letters are of much inferior brilliancy. The mode of fixing all the letters and numerals of this class is by passing pins through ears, one, two, or more, formed on the edges of the foundation plates.

Letters of this description, instead of being formed of a yellow glass, or yellow and white glass, so as to have the appearance of gold, may be formed of other coloured glasses combined in the same manner, and silvered or quicked at the back.

4. Another class of letters and numerals, of a very beautiful description, is formed by the combination in manner following of a number of small irregular cubes of cut glass (called in the glass trade, "brilliants,") and which may be had of all colours, as white, emerald, canary, ruby, and made of any required form, as round, square, oblong, &c. If a letter, or numeral of this class, is to be attached to an opaque surface, as a stucco front, or wooden sign-board, I quick each piece at the back, or on the under face in the same way as before mentioned, and solder to the quicking a metal pin by which the piece may be either affixed directly to the stucco front or sign-board, or other show-place, or made fast to a foundation plate of zinc or tin, provided with ears for fixing it up, as before explained. The pieces are put on in rows above or alongside of one another, and in such order as to form a distinct representation of each particular letter and numeral. If, however, the letter or numeral is intended to be attached to a transparent surface, as a shop window, then I dispense with the quicking, and attach the pieces to the glass of the window by means of some cement which will not materially impair the lustre of the brilliants. And sometimes, in order to improve the effect produced, I make use of two brilliants, one on the outside of the glass, and one on the inside, placed with their bases exactly opposite to one another. The best cement for this purpose would be a solution of gutta percha, because of its being water-proof, and not affected by any degrees of temperature known to this climate, provided it could be procured colourless, or nearly so; but as in the state in which it is now ordinarily sold, it is of a yellowish or brownish hue, I can only recommend it to be employed in the case of brilliants of the darker colours, such as ruby, green, or purple. Failing colourless gutta percha solution, the cement most proper to be used, according to my experience, is the varnish known among japanners by the name of "White Varnish," which is composed of gum sandarac and Venice turpentine, and rectified spirits of wine; but there are various other cements and varnishes, which if properly decolourised (which most of them are susceptible of being), would answer the purpose, and I do not therefore limit myself to the use of any particular cement. Instead of making such letters and numerals wholly of brilliants, other descriptions of glass ornaments may be intermixed, as shells, leaves, flowers, &c.

5. Flat letters and numerals of a description also very suitable for windows and other transparent surfaces are made in manner following:—I have flat pieces of glass of any desired colour, as yellow, green, ruby, &c., made by casting or cutting of widths and lengths, suitable for being formed into letters with rows of holes up the middle of them of a circular, oval, or diamond, or any other fancy shape; and I affix these pieces to the window glass, or other transparent surface in the positions requisite for forming the letters or numerals by means of any of the cements mentioned in the preceding section. Or instead of making such letters of glass, I make them of brass or zink, and in that case, use indifferently any sort of cement, whether transparent or opaque, which will attach the metal to glass. The holes in these letters and numerals impart to them a very striking character, and enable them to be seen at night, when any flat unperforated letter, or numeral, would be only very imperfectly visible.

6. I make glass letters and numerals,

suitable for all situations, and at a very cheap rate, out of tubular glass, in manner following:—The glass may be either altogether opaque, like opal, or of the sort called opal, or partly opaque and partly transparent, the opaque and transparent parts alternating with each other in straight or curved lines, or in forms of any other character, and it may be of any colour or combination of colours. It is drawn in entire tubes of any required size, in the usual way of drawing such tubes. In order to form these tubes into letters and numerals, I cut them lengthwise into half-tubes, quarter-tubes, or tubes of other portions of a circle, according to the breadth and length desired to be given to the letters or numerals, and afterwards I cross-cut these half-tubes, quarter-tubes, &c., into short lengths, with either square or bevelled ends, as may be required; I then form the letter or numeral by laying the semicircular or segmental pieces of which it is to consist, with the flat side undermost, on a foundation-plate of zinc or tin, made with small side wings at suitable distances apart, which, after the pieces have been arranged in their places, are turned up so as slightly to overlap the pieces and hold them fast, yet not so tightly but that they may expand and contract freely under variations of temperature.

7. Projecting and transparent letters and numerals may be constructed on the same plan as the brilliants, described under the fourth section, but on a much larger scale, and at a great reduction of cost, by substituting for the brilliants half globes of blown and fire-polished glass, which, like the brilliants, may be of any desired colour. Such globes may be made either with a solid diaphragm on the chord line, or quite hollow, so as to allow in the latter case of their being gilt or silvered inside, or inlaid with any other description of ornament.

8. Letters and numerals of a kind, to which I give the name of "Medallion letters or numerals," are formed by imbedding in plaster of Paris glass brilliants or other glass ornaments, similar to those before described, in the order of arrangement and combination requisite to form such letters and numerals, covering the same over with glass, and setting the whole in a tin or zinc case made to suit, coated to resemble stone, and provided with a narrow flange at top, which may be turned over upon the glass, and with projecting eye pieces at the back, by which the case may be secured to the house front or other place, which it is destined to occupy. The mode of imbedding the brilliants is precisely the same as that before directed to be pursued in underlaying wall tablets with similar ornaments. All the cases of these medallion letters and numerals should be of exactly the same dimensions.

Another mode of forming "medallion letters and numerals" is as follows:—The figure of the letter or numeral is pinched into a mass of glass of a plano-concave form, in the manner well known to glass pinchers; the flat side is quicked, and the round side fire polished. Metal pins are soldered to the quicking, and the medallion secured thereby, with the flat side undermost, to the place where it is to be exhibited.

9. And, finally, I apply the various modes of and materials for forming letters and numerals before described, either in whole or in part, to the formation or embellishment of the coats of arms, trade emblems, and other devices commonly used to designate and decorate public offices, shops, hotels, taverns, &c., preferring more especially for this purpose the brilliants described under the fourth section of this head of my specification. I apply also the mode of pinching used in the formation of the medallion letters and numerals to the production of the caps of pillars, pilasters, and other architectural ornaments.

Ninthly, my invention consists in the following improved mode of fitting up the interiors of houses where the walls are intended to be covered with paper hangings, or plastered and painted. Supposing the four sides of a room to be divided into equal compartments, I cut out an open recess of any appropriate form in each compartment, at a height of about five feet from the ground; and I insert therein a tablet formed in the manner described under the second head of this specification, and exhibiting underneath the upper glass the representation of some striking pictorial object, as a statue, a bust, a vase of flowers, &c.; or, in place of the tablet, I insert a circular mirror, or plano-convex or plano-concave lens, with an actual piece of sculpture, or sculpture cast, placed behind it. The recesses should be surrounded with mouldings formed in the plaster, and the paper hangings (where such are used) should be made with bordered apertures in them to fit the recesses exactly. The plan just described admits of many modifications; but, as they will readily suggest themselves to all persons conversant with the art of household decoration, any further exemplifications are here unnecessary.

Tenthly and lastly, my invention consists in the application of certain parts of the improvements before described to the embellishment of articles of furniture.

Flat tablets and plates, formed by any of the modes hereinbefore described, may be employed as panels in cabinets and cabinet

work of every description, as chimney-pieces, as tops of console and other tables, as door finger-plates, as side plates to stoves and fire-places; and, generally, as a substitute for flat surfaces of all sorts in articles of furniture.

Frames for looking-glasses and pictures may be formed of glass, with the gilding or with the materials productive of the appearance of gilding, underneath the glass, in the same way as the raised architectural ornaments and hollow gilt letters before described.

Curtain-poles, having the appearance of the highest gilding, may be formed of a tube of white glass, with a wooden pole inside made to fit it as exactly as may be, and having a bordering of gilt paper wound round it, or rows of the same bordering pasted along the front half of the pole.

Curtain-poles, of a sparkling, silvery appearance, may be formed of a glass tube, coated on its inner periphery with glass frostings, in the manner hereinbefore explained.

Window cornices may be formed of yellow glass, silvered or quicked, and cut to pattern by a glasscutter in one or more pieces. If cut in points, as gilt cornices generally are, I hang to such points yellow beads, blown to represent the bobbins now used; and these I twist with spun glass, in imitation of the silk now ordinarily employed for the purpose.

THE SEA-WALL QUESTION.

Sir,—It may be a mistake to suppose that the arguments in favour of an upright face proceed upon the assumption that the motion of the sea is wholly vertical—I may be wrong in thinking so; but I certainly have the idea that all, or nearly all, who advocate the theory of a vertical profile, form their reasoning upon some such supposition. I should be very sorry to attempt an argument upon what appears to me to be a very slender basis; and I quite agree with Mr. Smith, that "no practical man ought to discuss the subject upon such a supposition."

There is a good deal of force in Mr. Smith's remark on a sentence which he quotes from a former letter of mine. Certainly it is both vague and unsatisfactory; I fear I am too much in the habit, when pressed for time, of expressing my ideas without being sufficiently explicit. I trust, however, to satisfy your correspondent that the sentence in question is not quite so ridiculous as he would have your readers suppose; for, let *abcd* fig. 1, be a vertical section of a wall, P_1 the force of the sea driving against it, P_2 the pressure of the water at the rear of the wall, P_3 = the weight of the superincumbent masonry, and P_4 = the resultant of the three last-named forces.

Now, so long as the line of resistance, P_4, is confined within the section *abcd*, the wall not be overthrown, and this principle of statical equilibrium, applicable to retaining walls, cannot be incomprehensible if applied to sea walls; for so long as the sea wall stands, the resolution of forces just exhibited must ensue.

I am free to confess that a sea wall is seldom, if ever, destroyed by reason of the force P_4 intersecting the line *cd*. But why is this? How does it happen that a sea wall though often breached, is seldom or never overthrown? What is the reason that the stones on the slope are thrown landward, and those forming the face of a vertical wall fall outwards from the effect of a gale? Why, because, from the nature of construction, the wall cannot be held together firmly enough to resist the force to which it is exposed *en masse*—because, individually, the stones are not sufficiently bonded to prevent the force of a blow from the sea breaking up the wall in detail.

If the wall were made in one piece, it is inevitable that if it yielded, it must turn round on the point *c*. And a sea wall *built* of stone does not do so, because the individual parts composing it are not bonded so as to make the whole act as one piece.

By an examination of the design, fig. 2, your readers will be enabled to judge if they think a wall can be bonded or cramped sufficiently for the blocks composing it individually to resist the violence of the sea. Let P_1, P_2, P_3, and P_4, be the relative forces in the wall, and P_5 be the resultant of the three forces, (P_2, P_3, and P_4,) then will P_5 be equal and opposite to the impinging force, P_1—and so long as P_1 acts upon the stone, A, is in equilibrium with it; but the instant the force, P_1, is removed by the return of the wave, the equilibrium is destroyed and the force, P_5, unbalanced, and it pushes, or at least tends to push, the stone, A, forwards.

I will not say it is impossible to prevent the stone, A, from being pushed forward; but it may well appear doubt-

Fig. 1.

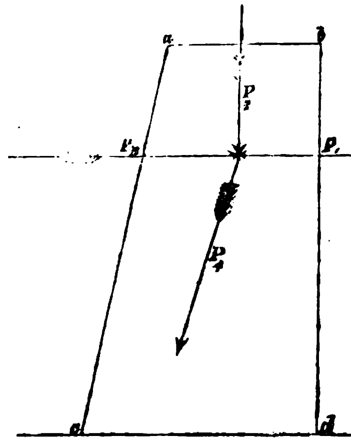
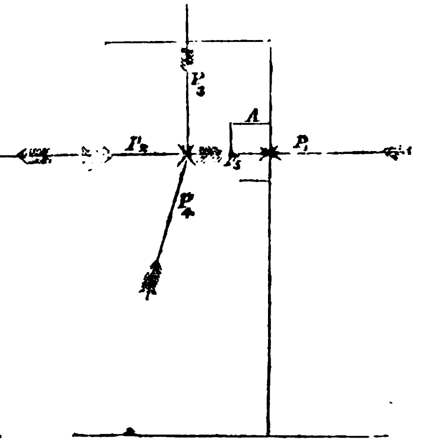


Fig. 2.



ful, when we remember that the force, P_1, sometimes equals three tons per square foot at least; of this we may feel assured, that the superincumbent weight will be wholly inadequate to prevent the stone moving.

I have now endeavoured to show,

1st, That the ordinary statical equilibrium applies in the case of sea walls.

2nd, That a sea wall is destroyed in detail, the action of the sea shifting each individual stone in its bed.

3rd, That if the wall were composed of one block it could not yield except by turning in the direction of the pressure; and,

4th, That a wall can only be built to assimilate to the action of a single block by being bonded perfectly together.

I therefore conclude that a vertical wall must depend for its strength upon its bond, and this not because the vertical wall does not possess the common properties of weight and breadth, but because, like the bundle of sticks in the fable, a wall, though it may possess both breadth and weight, will, unless it be well held together, be destroyed in detail, and become an easy prey to the element by which it is surrounded.

I am, Sir, yours, &c.,

WILLIAM DREDGE.

London, 16, Norfolk-street, Strand,
August 21, 1848.

REPLY TO SOME OBSERVATIONS IN A PAPER ENTITLED "ON SEA WALLS," IN VOL. XLIX. OF THE "MECHANICS' MAGAZINE."

In vol. xlix. of the *Mechanics' Magazine* is a paper containing observations on the opinions of scientific men respecting the forms which should be given to the vertical sections of sea walls and embankments in the ocean; in which paper the writer, Mr. Smith, while appearing to lean towards the side of those who advocate a slope for each side of the work, rather than to that of such as have proposed to build the faces of the walls in vertical positions, asserts that the former are bound to show cause, why the force of the sea in striking against an inclined plane composed of stones, disposed at random, should not produce displacements among them, driving them over the top of the embankment, or, by drawing them downwards, scatter them over the bed of the sea. The precise words here given, are not those of the paper in question, but they will, no doubt, be admitted to express the sense of the assertion. Now, if breakwaters were formed of small stones which, by attrition or otherwise, had been completely rounded, there is little doubt that such effects would take place till the whole mass were removed; it is, however, superfluous to say that, in the formation of sea embankments no such stones are used; massive blocks, weighing often several tons, and of angular forms, being allowed to descend into the sea by gravity, become engaged with one another in a manner nearly resem-

bling the Cyclopean masonry of the ancients; and abundance of smaller blocks, or fragments, being at the same time thrown into the water, the spaces between the greater masses may be conceived to be nearly filled up, so that the whole at length assumes, in a great degree, the solidity of a natural rock, the exterior blocks serving by their weight to compress into a connected body those which lie beneath them; and the base being further cemented by the sand and gravel from the bed of the sea, which in time deposits itself in the interstices.

It is true that, on the vast surface of such a breakwater as that which secures the harbour of Plymouth, at the first formation of the work, thousands of tons of stone must have rolled down loosely; and these, by the action of the sea in violent storms, would necessarily be displaced: such was the fact; but instead of this action continuing "till the work of destruction is consummated" (*Mech. Mag.*, vol. xlix., p. 157, col. 1), as the writer of the article assumes, speaking of breakwaters in general, this superb monument of the power of man to control the waves remains immoveable, and appears likely to stand entire while the harbour shall exist.

Mr. Smith assumes that the exterior of a breakwater, when subject to the action of waves, is formed of blocks in part projecting from the general inclined plane of the surface; and, on this supposition, he rightly shows that some of the resolved parts of the force of the water, in striking, will tend to remove the stones, and roll them up or down the plane; but can he be ignorant of the fact, that a great part of the resolved forces will act perpendicularly to the general surface of the plane; thus contributing mightily with the force of gravity to press the exterior blocks upon those within them, and tending to consolidate the mass? Can he be unaware also that many thousands of blocks, on descending from the vessels which convey them from the quarries must, among the *accidents* of their fall, assume positions in the mass, in which they may act by gravity as wedges, rude, indeed, but capable of retaining one another in their situations? And, above all, why does he overlook the fact that the sloping face of a breakwater scientifically constructed is presumed, in its finished state, to be paved, within the limits to which the action of the waves extends, with great stones, so as to form really an inclined plane, the stones being roughly squared and placed with their broader surfaces perpendicular to the face of the wall; that care is taken to make the interstices as small as possible; and, finally, that whatever damages may be caused by the sea in gales of wind are immediately repaired? Under such circumstances, it may be safely presumed that the work possesses the requisite stability; and it may be further presumed that an answer has been given to the observations propounded concerning the displacement of the materials composing such structures.

Persons into whose hands Sir Howard Douglas's "Protest against the Decision of the Members of the Harbour of Refuge Commission" may come, will look in vain in that paper for a passage which by any ingenuity can be made to signify "that a given weight having a force applied to it horizontally is more easily pushed up an inclined plane of 18° than up one of 11°," (*Mech. Mag.*, vol. xlix., p. 157, col. 2); the circumstance is too absurd to have been asserted by any one having the least pretension to a knowledge of mechanics. The only part which relates to the resolution of forces is in a note to art. 2 of the "Protest," where it is stated that the horizontal impulse of a fluid on the surface of a resisting body increases with the increase of the angle at which the surface of the body is inclined to the horizon. (The weight being constant, a given impulse, acting horizontally, exerts an effort to move the body in the same direction, which varies *directly* as the square of the sine of the inclination of the surface to the horizon.) It is presumed that Mr. Smith could not intend to controvert this well-known law.

No opinion is expressed in the "Protest" concerning the precise form which should be given to a transverse section of a sea embankment; and it is merely intimated in the same note that the face may have different inclinations to the horizon in different parts of its height, the part lashed by the waves requiring, conformably to the law above mentioned, less inclination than the parts below. So far from any opinions stated in the "Protest" being capable of bearing a meaning

like that which Mr. Smith has ascribed to them, both M. Emy, a French engineer, and Mr. George Rennie expressly lay down, that walls with long slopes resist the action of the waves better than others, and that their degradation is less in proportion as the slope is more gentle.

The opinions of the distinguished persons here mentioned, are not cited as evidences of any fact, but are stated in order to show that the writer of the paper on sea walls has given, as consequences of the principles affirmed by experienced engineers and scientific men, circumstances which can by no process of reasoning be connected with them; or, rather, which are directly contradictory to them, and which apparently exist only in his own imagination. Hence, what is said at the bottom of p. 157, col. 2, and on p. 158, (*Mech. Mag.*, vol. xlix.,) falls to the ground; and it may be safely assumed that no person ever assented to, or in his writings implied, the affirmative alluded to on p. 158 of that volume.

In a more recent number of the same work (p. 181), Mr. Smith gravely puts the question: Do these facts (the stability of a sandy slope when washed by the waves of the sea, and the mobility of loose stones when acted on in like manner) furnish an argument in favour of a long rough sea slope for a breakwater? Probably, most persons will be disposed to think that the difficulty would lie in showing that they furnish an argument against it. The smallest sands of the sea shore, if not protected by some covering, are raised by the waves; and often, in violent storms, are thrown far inland; when, from the height of the coast, this does not happen, they are carried up and down the beach till, by the return of calm weather, they are enabled to deposit themselves again on the shore, leaving this, in some situations but not in all, nearly in its original state. The effect is similar on the loose stones, and those only of a sea embankment; these also are in violent storms impelled up and down its sloping face; and, if the work be not sufficiently high to prevent it, the stones may be forced over its summit, as the small materials of the sea shore are driven over the land. Similar remedies are applied in both cases; the sandy slopes on the coasts of Holland are covered with straw, and the stone embankment may be paved in the manner before mentioned.

The disporting of rocky fragments among the waves, described p. 181, col. 2, would furnish a very powerful argument against a sea embankment with vertical sides. Those fragments must, by the beating of the waves, have been severed from the original rock; and being then hurled by waves against it, they must accelerate its destruction. The same words, very nearly, would serve to describe the fate of a wall with sides rising vertically from the bed of the ocean.

THE VALVE OF MR. WALKER'S HYDRAULIC ENGINE.

Sir,—Having lately been invited to visit Mr. Walker's factory to inspect his new hydraulic machine, I was much gratified by a perusal of the 1305th Number of your valuable Magazine, which furnishes a very perfect elucidation of the general arrangement of its parts. There are, however, a few facts connected with it which cannot be too strongly placed before your readers and the scientific world generally. One of the great features of improvement in Mr. Walker's hydraulic machine will be found to arise from the peculiar construction of the piston, which is less likely to *choke* than in any other arrangement that has yet been constructed. A reference to your engraving fig. 5, p. 149, will show that the entire valve consists of a series of small light cylinders, and any person who has examined the practical operation of these cylinders in a glass model, will find that they rapidly revolve on their seat while the water is passing through the piston, so that the natural tendency is to free the valve from any impediment. This is an advantage of great moment both for the purposes of irrigation and the raising of water from the hold of a vessel, as many ships have been lost in consequence of the choking of pumps constructed on the ordinary principle. The next fact is, that the course of the ascending column of water is much less disturbed in this form of hydraulic machine than in the common pumps, so that the momentum of the water is retained till it is discharged into the reservoir above. The importance of retaining this momentum is shown in the action of the hydraulic ram, in which water is

raised by its operation to a considerable altitude, and if, as in the valve of the common pump, we suddenly check the action of the water, the power thus wasted is destructive of the valve itself. Another, and scarcely less important feature, is the small amount of water that returns when the direction of the piston is changed, and in this respect Mr. Walker's valve closely approximates to the wonderful mechanism of the human body, as the valves of the heart admit of the least possible return of the fluid they are intended to support.

I am, Sir, yours, &c.,
C. F. P.

SELF-ACTING SLUICES.

Sir,—I should feel great pleasure in being able to afford your correspondent, "S. S.," page 178 (*ante*,) any useful information in my power upon the interesting subject of self-acting sluices, the mechanical action of which was investigated by me, at page 87 of your current volume. Judging, however, from his method of calculation given at page 179, I fear I shall be able to do but little in reconciling his peculiar views to the results of my investigation; and I regret this the more since he seems inclined to attach to the subject the amount of importance it unquestionably deserves.

My "*practical deductions*," page 88, are calculated for a particular case, the details of which are given in the same page; but the results there obtained must not be applied indiscriminately, as "S. S." has done to other imaginary cases. If your correspondent will only apply the general formula, page 87, he will find results to suit *his* particular case; but his deductions in page 179 are of no value in connection with my investigation.

Your correspondent says, "I am of opinion that the *average opening* would prove a more correct measure of the discharge of water, than the extent of opening at the *lower edge*." From the idea expressed in this extract, and the arithmetical process which accompanies it, I entertain some fears that the "*average openings*" referred to by "S. S." have been conceived in a misapprehension of the law which obtains in the discharge of fluids. Surely he must know, that one foot of opening at the sill of the sluice, may be equivalent, as regards discharge, to four feet at the surface of the fluid; and we cannot, therefore, take an arithmetical mean, as "S. S." *has done*, between those openings.

Of all the disadvantages which belong to a sluice with long arms or hinges, the most important is that which results from the position it assumes in front of the tunnel doors. There it hangs, almost parallel to the jambs of the door, a rigid body, most effectually preventing all *direct* discharge, and admitting only a passage for the water *indirectly* around its sides and over its upper edge. It is not beyond the power of mechanical science to estimate the amount of this obstruction; but if the object of "S. S." is simply to decide upon that which is right, as distinguished from that which is wrong, let him satisfy himself by personal observation on the action of each description of sluice. I entertain a hope that after having done so, "S. S." will agree with me, that in addition to the anti-mechanical principle of the long-armed sluices, their practical action is a positive aggravation of their other inherent faults.

I am, Sir, yours, &c.,
T. SMITH.

Bridgetown, Wexford, Aug. 23, 1848.

THE "FAST AMERICAN PRESS" OF ENGLISH ORIGIN.

Vine-street, York-road, Lambeth,
London, Aug. 29. 1848.

Sir,—Trusting to your well-known impartiality, I beg the favour of a place for a few words in your useful Magazine, upon the article supplied to you from the *Eureka*, and published in your Number of the past week, respecting what is called, "Hoe's last Fast Press." The article would have been left unnoticed for me, had the Atlantic proved a sufficient barrier against the spread of such fulsome falsehood; but when it comes thus far, and insinuates its slimy proportions with a fair face into our public journals, it is high time to strip it of its gorgeous cloak of words, and show in full relief its truthless shape.

It is quite clear that the entire article has but one end to serve, and as that end shall prove, so let the prelude rank with truth or falsehood. The way to the mud is through the mire; so in this case, after wading knee deep in the polluted soil of historical exaggeration and corrupted facts, Messrs. Hoe, (for who can suppose that the article has emanated from any other quarter?) blinded by a

desire of renown, plunge overhead into the slough of culpable self "appropriation," which first begets barefaced "repudiation," and ends in composed and settled "annexation." I am not inclined, however, to leave Messrs. Hoe "all alone in their glory"—the crown sits loosely upon the head of an usurper, and so "this principle entirely new throughout"—"this machine, constituting as it does an era in the history of printing"—yes, this most flourishing laurel in the wreath of Hoe, must be plucked off to grace a worthier brow—the brow of one in whose mind, more than ten years ago, this far-famed press of Hoe's was all complete. There was the cylinder of large dimensions, revolving on an axis just the same; the common type fixed to its surface, as described; and all the space the "form" could spare made to distribute ink; then came the smaller cylinders—they placed themselves around, just twice as numerous, indeed, but in position no way differing; tapes, too, brought sheets, which passed in quick succession round each smaller cylinder, and meeting with the whirling type received its impress; then, by another route, sped back and found repose, each on a separate board. Nor were these things confined to the mind alone of the inventor, for they soon became the subject of a patent, the specification of which was in due time enrolled and laid open to the world. It may be objected—"but how do you know that Messrs. Hoe were aware of such a patent existing?" I answer, because Mr. Hoe was in London after the patent was obtained, and the invention was then fully explained to him, and many details which were not described in the specification, to which, of course, he had free access, were liberally laid before him, by the inventor himself in a friendly way. Some time after Mr. Hoe had left Europe, a rumour reached this country that such a machine was in course of construction, under Mr. Hoe's superintendence; and now we have this machine exhibited clearly enough in your pages, as the production of this same honest American, though, in truth, the invention of David Napier.

That Messrs. Hoe are the first who have made the machine is no doubt to their credit, or perhaps as much so to the "go ahead" character of the American papers, as they have not failed to appreciate what has in vain been laid before these newspaper proprietors in this country, who have the greatest need for speed in publication. Probably the fact that America has made use of the invention may rouse up those in this city who are groaning under the pressure of numbers, and who require continually to plead excuses for the lateness of delivery by throwing the blame upon the inefficiency of their printing machinery.

The insertion of these facts in the cause of truth will oblige,

Your obedient Servant,

JAMES M. NAPIER.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Edward Dench, of Hurstperpoint, Sussex, hot-house builder, for improvements in the roofing of conservatories, hot-houses, and other like structures. August 26; six months.

William Young, plumber, and Henry Burgess Young, engineer, both of Barnstaple, Devon, for improvements in smelting and refining lead ores. August 28; six months.

Charles Rowley, of Birmingham, button manufacturer, for improvements in the manufacture of buttons. August 28; six months.

Elizabeth Chrees, of Homerton Castle, Homerton, Middlesex, for improvements in the manufacture of sealing wax. August 29; six months.

Peter Wright, of Dudley, Worcester, vice and anvil manufacturer, for certain improvements in the manufacture of vice boxes, and in the machinery for effecting the same. August 31; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Aug. 25	1550	Isaac Rider	Bedminster, Bristol	Bib cock.
26	1551	Alexander Lewis	Fenchurch-street	Protective machine for cleaning, painting, and glazing sashes.
,,	1552	Messrs. Wilson	Wardour-street, Soho	Artists' sketch box.
,,	1553	Arthur Perks Dudley	Birmingham	Trouser strap.
28	1554	J. and W. A. Blair	Irongate, Glasgow	Compass hats.
,,	1555	Wm. English and Son,	Brighton and Lewes, Cutlers and Surgical Instrument Makers	Dr. Madden's uterine douche bath.
29	1556	Jn. Crutchley de Witte,	43, Threadneedle-street	Pen holder.
,,	1557	Hilliard and Thomason,	Birmingham	Fastenings for articles of dress.
30	1558	J. Tylor and Son	Warwick-lane	Flush lap joints for metal grooves.
,,	1559	Henry Walker	Gresham-street, London	Penelope Crochet needle.
,,	1560	William Norris	Gloucester-place, Hackney	Wood frame soap-cooler.

Advertisements.

The Railway Record,

(EDITED BY JOHN ROBERTSON, M.A.,)

IS published early every Saturday Morning, and contains full and exclusive Reports of all Railway Meetings, with the Official Documents in full; Railway Law Cases, Railway Share Lists, and Traffic Returns, and all matters affecting Railway Proprietors. It is considerably larger than anyother Railway Paper, and is exclusively devoted to this branch of enterprise.

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Price 6d. stamped; Office, 153, Fleet-street, London.

GUTTA PERCHA COMPANY'S WORKS,

WHARF ROAD, CITY ROAD.

London, 1*st April*, 1848.

THE GUTTA PERCHA COMPANY have great pleasure in stating that the steadily increasing demand for the PATENT GUTTA PERCHA DRIVING BANDS justifies the utmost confidence that they are fully approved.

Their durability and strength—permanent contractility and uniformity of substance—their non-susceptibility of injury from contact with Oils, Grease, Acids, Alkalies, or Water—and the facility with which the single joint required can be made in Bands of any length—render them superior for almost all working purposes, and decidedly economical.

GOLOSHES, TUBING of all sizes, BOUGIES, CATHETERS, STETHESCOPES, and other Surgical Instruments; MOULDINGS FOR PICTURE FRAMES and other decorative purposes; WHIPS, THONGS; TENNIS, GOLF, and CRICKET BALLS, &c., in great variety,

Patent Gutta Percha Shoe Soles.

The applicability of Gutta Percha Soles for Boots and Shoes having been extensively and satisfactorily tested, we can unhesitatingly recommend the material prepared for this purpose, its merits having been acknowledged by all who have tried it. Indeed, experience has proved that Gutta Percha Soles wear twice as long as leather, with great additional personal comfort; and they remain perfectly impervious to wet until quite worn through.

Boot and Shoe Soles for Summer Wear.

The fact of the total imperviousness of these Soles to water, enables the most delicate, by the use of them, to escape the suffering which the proverbial uncertainty of our climate, EVEN IN SUMMER, so often inflicts upon the incautious, and this effect may be secured by a Sole so thin and light, as to afford to the wearer a degree of ease and comfort hitherto unattainable, in conjunction with security against damp.

At the same time, the remarkable non-conducting properties of Gutta Percha afford a most valuable protection to those who are subjected to suffering or inconvenience by walking upon heated pavements.

The question of the durability of Gutta Percha Soles, as compared with Leather, has long since been decided in favour of the former; **and no instance of failure has yet come to the knowledge of the Company which may not be ascribed to a neglect of their printed Directions.**

What to Eat, Drink, and Avoid.

SOUND DIGESTION! What a boon! but what a rarity! All the wealth in the world cannot buy it, and yet how simple it is to secure it. Dreamless nights!—How refreshing is a good night's rest, and how few obtain it! How fearful is illness, and who have we to blame for it but ourselves? Physic is one evil to cure another; but caution keeps off more fire than water quenches. Reader, if you value the desiderata of good health in the day, and tranquil repose at nights, together with mental serenity at all times, or should lack firmness of nerve or purpose, or suffer from the sorrows of an afflicted body, seek how to obtain the former, and remove the latter, in DR. CULVERWELL'S little Memoirs, called "HOW TO LIVE, or WHAT TO EAT, DRINK, and AVOID;" and its Companion—"HOW to be HAPPY" (the price is but 1s. each; if by post 1s. 6d. in stamps.) They recommend no nostrum, pill, or balm, but render every possessor master or mistress of his or her own case. They tell home-truths, and detail facts that may astound—but which are worthy of recognition; and they furthermore unmystify the laws of life, health, and happiness; that how to live happily and contentedly, is rendered clear and open to the humblest intelligence. To be had of Sherwood, 23, Paternoster-row; Carvalho, 147, Fleet-street; Mann, 39, Cornhill; Nelson, 457, West Strand, and all booksellers; or direct from the Author, 10, Argyll-place Regent-street, who can be personally conferred with daily till four, and in the evening till nine.

NOTICES TO CORRESPONDENTS.

Mr. Murdoch—Mr. Baddeley—Mr. Boole, in our next.

"Bio" *declined.*

If "A. N. Q." *will throw his lucubrations into a readible form we will insert them.*

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co. Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1309.] SATURDAY, SEPTEMBER 9, 1848. [Price 3*d.*, Stamped, 4*d.*

Edited by J. C. Robertson, 166, Fleet-street.

MR. MAUDSLAY'S PATENT SELF-ACTING STERN PROPELLER.

Fig. 1.

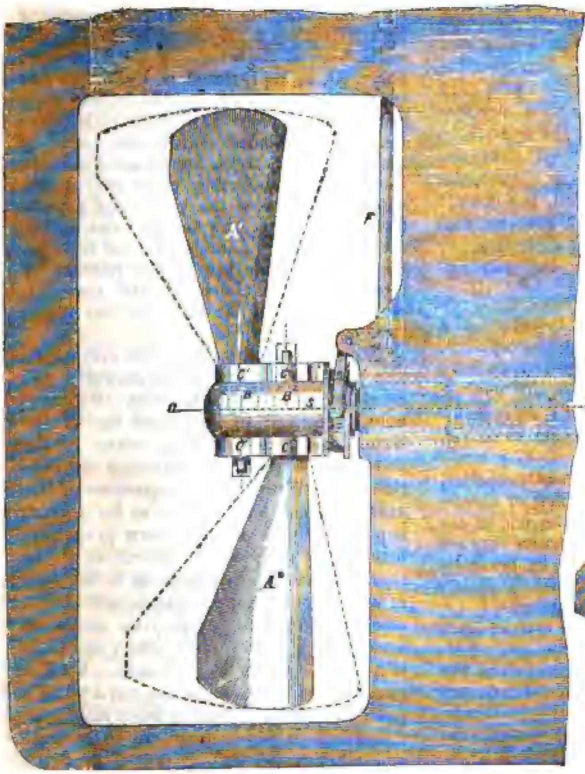


Fig. 2.

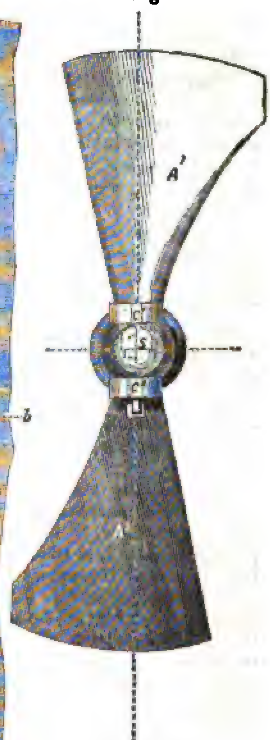


Fig. 3.

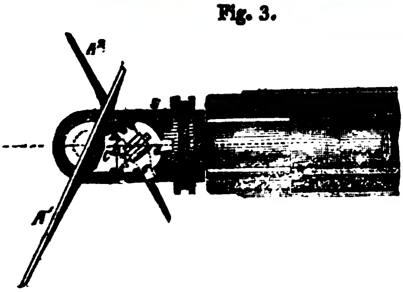
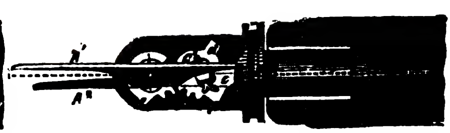


Fig. 4.



MR. MAUDSLAY'S PATENT SELF-ACTING STERN PROPELLER AND ARCHIMEDEAN BOILER FURNACE.

[Patent dated March 8th, 1848. Specification enrolled Sept 8th, 1848.]

1. The new steam propeller which forms the leading subject of Mr. Maudslay's present patent, obviates one of the greatest obstacles that have hitherto stood in the way of steam propelling, whether by means of screw blades or flat blades, or blades of any other description; viz., the difficulty of shipping and unshipping the propeller. Mr. Maudslay affixes the blades of his propeller (which may, he says, be of "any approved or suitable form") in such a manner to the driving-shaft that the propeller assumes of itself, as it were, the proper angle for propulsion, the instant the driving-shaft is put in motion, and returns as instantly into a neutral or inoperative position when the driving-shaft ceases to rotate.

Fig. 1 represents part of the stern of a vessel fitted with this improved propeller; Fig. 2, a front view of the instrument detached from its place in the vessel; and fig. 3, a sectional plan of the propeller and its connections on the line *ab* of fig. 1.

A^1 A^2 are the blades of the propeller, which are inserted at their inner or narrow ends into sockets, B^1 B^2, in the end of the propeller-shaft, S, in which sockets they are free to turn to the extent to be presently defined. To the shank of each propeller blade there are two toothed segments, C^1 C^1, C^2 C^2, attached one at the top of each socket, and the other at the bottom of it; and the two sets of segments work the one into the other within the limits determined by the stops, *ff*, so that the propeller-blades must always move in perfect unison, and can only turn round in their sockets to the extent allowed by the stops. E is a sliding clutch, affixed to the driving-shaft inside of the propeller-blades, which may be moved sternwards, so as to lay hold of either of two sets of pins, *dd* and *ee*, which project from the back of the wheels of the innermost propeller-blade, A^2. F is a vertical rod, by means of which the clutch, E, may be worked from the deck of the vessel; this rod terminating at bottom in a screw, which takes into a swivelled nut, *n*, which is attached to one arm of a bell-crank, G, the other arm of which is forked so as to embrace the clutch, E, when brought down upon it. The mode in which the propeller, as thus fitted, acts, is as follows:—Supposing the clutch to be disengaged, and the driving-shaft to be put in motion, the blades are immediately thrown out into the angular positions proper for propelling, and they will continue in these positions as long as the shaft continues to rotate. Should occasion arise for backing the vessel, the blades are then secured in their extended positions by interlocking the clutch with the pins, *dd*, at the back of the wheels of the innermost blade, A^2, as represented in fig. 3. When the engine is stopped, and the driving-shaft ceases to rotate, and the clutch is withdrawn, the propeller-blades will, by the action of the water upon them, be turned round in their sockets until they come into a line with the course of the vessel, and present their sharp edges only to the water, as exemplified in fig. 4; and, for greater security, they may be made fast in this position by interlocking the clutch, E, with the pins, *ee*, at the back of the wheels of the innermost blade.

From the instantaneousness with which this peculiarly fixed screw propeller can be turned to account, from its never being required to be raised out of the water, and never offering, when in the water and at rest, any material obstruction to the steering or progression of the vessel, it seems to possess so far a great superiority over all the screw propellers hitherto in use; but it promises to be more especially advantageous in the case of vessels going long voyages, with small store of fuel, and employing steam as an auxiliary power only, when the wind is not fair for the use of sails. With a propeller of this description, not a minute need be lost, in changing from sailing to steaming, or from steaming to sailing, and consequently, not a pound more of fuel need be expended than is absolutely required.

2. The peculiar feature of Mr. Maudslay's new furnace consists in the employment of rotating tubular screw bars, and hence the name ("Archimedean") by which we (not Mr. Maudslay) have ventured to distinguish it. Fig. 5 is a longitudinal section of the furnace; and fig. 6 a front view.

HH, are the fire-bars which, instead of being as usual solid fixtures, consist of a series of tubes which are free to revolve in their bearings, are open from end to end, screw-threaded on the outside, and perforated with numerous air-holes. On the front end of each

Fig. 5.

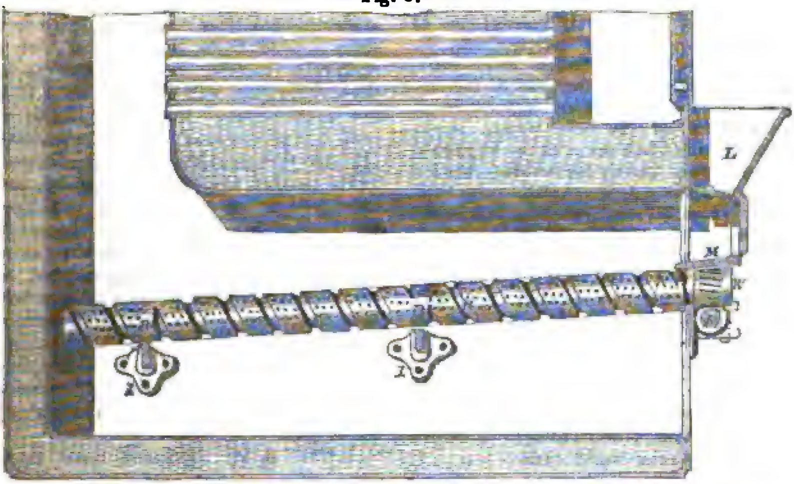
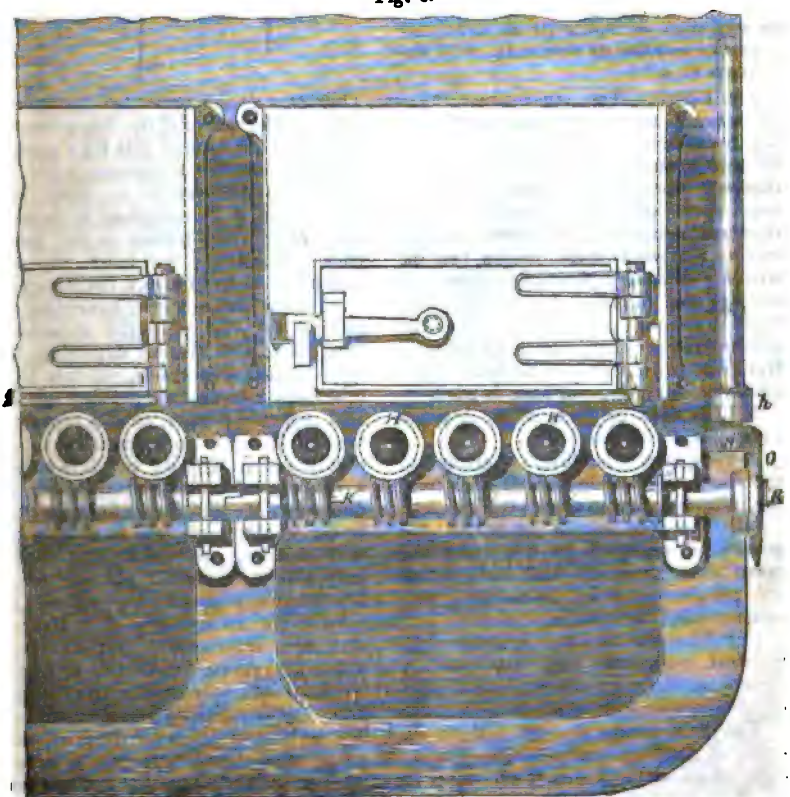


Fig. 6.



bar there is a broad flange or shoulder, *f*, which projects beyond the general line of the furnace, and has a worm-wheel, W, formed upon it. An endless screw-shaft, K, which passes across the front of the furnace, and is worked from the engine through the medium of the bevel-wheels, N, O, takes into the whole series of worm-wheels, W, and causes thereby the constant rotation of the fire-bars. L is a throttle-valve hopper by which the coals are supplied to the furnace. As the coals drop from the hopper they fall upon an inclined shoot, M, which projects them upon the front end of the furnace bars, whence they are carried gradually forward to the back, by the rotation of the bars and the action of their screwed surfaces on the mass of fuel.

In consequence of the bars being in this constant state of rotation it is almost impossible that either clinkers or ashes should accumulate upon them.

ON THE IDEA OF FORM TO BE ATTACHED TO THE POWERS OF NUMBERS. BY "EX-REVIEWER."

Mr. Editor,—The paper signed "TATROMATHEMATICUS," in your last Number, is exceedingly ingenious, and cannot be the production of any but a *real thinker;* albeit, his thoughts may have been spent more upon other subjects than mathematics. Particular circumstances lead me to think, indeed, that the writer is *the very first physiologist of our age and country;* but whether I be right or wrong in this, I am sure the author will excuse my somewhat differing from his special views on both the topics which he discusses,—at least *in part.*

1. *The idea of form to be attached to the powers of numbers.*

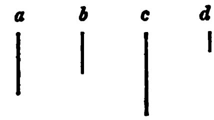
A great deal of confusion is created in the minds of young mathematicians from the following circumstances:

(*a.*) That the *names* by which the powers of numbers are expressed are taken from processes and ideas which are peculiar to *pure geometry:* viz., square, cube, sursolid, &c.

(*b.*) That the *notation* in which geometrical magnitudes are expressed is directly copied from the notation of *pure algebra;* viz., AB^2, AB^3, &c.

This interchange has been the main cause of the perpetually-occurring difficulty which mathematicians encounter in all their attempts to demonstrate the distinctive boundaries of the ancient and modern geometries. As long as we consider a product to be *identical* with a rectangle, instead of *analogical* to it, these difficulties will cling to us. It is not a question of language, visible or oral, but of the *mode of our conceiving* the two things. The *analogy*, indeed, holds perfect for the first, second, and third powers of numbers with the line, area, and solid; but there it "comes to a dead stop." We cannot conceive more than three dimensions of space; but we can conceive higher powers of numbers than the third. The very circumstance of the want of continuity in the analogy beyond a certain stage, is a complete proof of the want of identity of conception, even to the extent that the analogy holds good.

Let *a*, *b*, *c*, represent three lines.



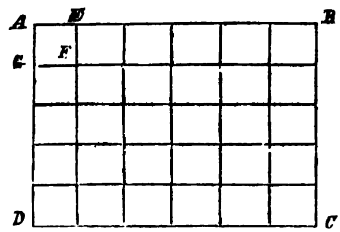
They may do this under two hypotheses. First, as the *names* of the three lines exhibited in the form of data for a problem or conditions for a theorem; and, secondly, as the *number of times* some linear unit, *d*, is contained in them respectively. The former is the geometrical conception; the latter, the algebraical (or more definitely, the numerical) one. Now, in the purely numerical conception we lose all sight of concrete quantities; and without departing from the *abstract conception*, we can in no other way interpret the *product ab*, than as *a* repeated *b* times, or as *b* repeated *a* times. There is no geometrical conception mixed up with it; and it is only by a *subsequent convention* that the product *ab* can be understood to represent an area. In the same way it is only by a corresponding and subsequent convention that the product *abc* can be understood to represent the volume of a solid. The conception of a rectangle and of a rectangular parallelopiped is *altogether foreign* to that of a product. There is not only no necessary connection, but there is no actual connection, beyond that which is *created* by subsequent convention. It may be instructive to examine both how this convention is made, and how it operates.

It is a remarkable fact, that geometry has always been in advance of arithmetic; and that the latter science has been continually obliged to fall back upon the former for a justification of every onward step it took. The antients were unable to investigate the commonest properties of numbers, except by reasoning upon *magnitudes* which were hypothetically to each other in the same ratio as the two numbers under comparison. What else were 7th, 8th, 9th and 10th books of Euclid, but an investigation of the fundamental properties of incommensurate and commensurate numbers, based upon the properties of lines which had the same ratio? The mystical treatise of Diophantus might perhaps be supposed to militate against this assertion: but what will be said if the properties which even *he* has given can be traced to a geometrical source—or at least established by reasonings having a great similarity to those employed by Euclid, and in no case requiring any *new principle?* I am able (so at least I believe) to establish this: but the present is not the appropriate time or place. The antients never treated ratio on the idea of the two magnitudes compared having a common measure: though it is more than possible that their *earlier* speculations might have been suggested by that particular case of the relation of the two magnitudes. For the distinction, however, between the two methods, I may refer to the elaborate and critical discussion of Professor De Morgan appended to his Trigonometry, under the title of "The Connection of Number and Magnitude."

Again, when $-a \times -b$ came to be discussed as a necessary case of general arithmetic, algebraists were obliged to fall back upon the evidences of *geometrical analogy* as the best they could offer for the assertion that $-a \times -b = \times ab$. To this, however, the second speculation of Tatromathematicus will require me to return with some detail, and it may, therefore, be passed without further remark just now.

Most of the so-called "applications of algebra to geometry" have been erroneously named: for they are rather (except the bald, mechanical, and incomplete imitations of Descartes) applications of geometry to the interpretation of algebraical investigations and results. This is emphatically the case with the very highest work of the whole class—that of Monge. Except in geometrical analogies, it is a fact that the more recondite results of algebraical investigation very rarely admit either of any interpretation or even of verification. On the contrary, after all the pretensions made by algebra to furnish geometry sometimes with wings and sometimes with crutches; yet the writings of Monge, of Dupin, of Poncelet, of Ollivier, and of Chasles, have proved that geometry is not only able to pursue its own course alone—but also to proceed at a pace such that algebraical analogies cannot even keep it within sight! But this is digressing; so let us return to the original question.

It was readily seen that if two lines, AB, BC, were *placed at right angles, and the rectangle completed*, and that if



these lines were actual multiples of some third line AE; and likewise that if $AB = a$ times AE, and $BC = b$ times AE; then there will be *as many* squares equal to the square AEFG upon AE in the rectangle ABCD, as there are units in the *product* of the numbers a and b. This holds good for any magnitude AE, which is an *exact submultiple* of AB and BC; but when we take AE incommensurate with one or with both the lines AB, BC, the *reasoning* by which the proposition is proved no longer holds good; and the conclusion can no longer be held to have been proved. At the same time it is not denied that if we admit $f(n)$, any function of n, to represent the number of times that AB contains AE, and $pf(n)$ similarly for BC and AE, there are unquestionable modes of extending the above referred-to proof to the cases which correspond with this very hypothesis. Yet the antient geometers knew no such modes of reasoning; and for the sake of logical purity, it is a happy cir-

cumstance that they did not discover any. I say it was "happy" because it threw them upon a course of investigation, which is alike unrivalled for its logical completeness and for the profoundness of its conception. They never "minced the matter," but seized the doctrine of ratio in all its generality; in fact, to an extent that few of us "degenerate moderns" fully appreciate. They never attempted (or at least if they did, their attempts in this way have been forgotten in the lapse of ages) to take even the *ultimate* common measure of two lines as the basis of their reasoning; but they have laid down a mode of comparing two magnitudes of the same species which seeks no "go-between," but which is wholly and directly dependent on the fundamental conception and definition of ratio—or rather, properly speaking, of "proportion" as defined in Euclid's fifth book. It is the most refined idea of the antient geometry—perhaps, of the antient philosophy altogether; and certainly amongst the most recondite of our modern speculations we find nothing which approximates more closely to the exercise of "pure intellect" (to use a phrase which it seems the tendency of the age to adopt from Kant) than this mode of comparing magnitudes. Admitting the fifth book* to be established, the whole doctrine is implied in *Euc.* vi., 23, and xi., 34. All idea of *numbers* is excluded from these views.

Now a product means only *repetition*, and in no way implies the idea of the formation of a rectangle, or of a parallelopiped. The stated relation is a *mere accident;* and without a subsequent convention could never have been discovered to possess the slightest analogy. All that we can legitimately understand by $a \times$ AE, multiplied by the *number* b, is, that AB is repeated b times, or that the result is a line b times the line AB; the line AE being considered as a concrete unit. The same would have equally held with a series of squares equal to the square AF, taken as a concrete unit; or to a series of cubes, or to a series of cannon-balls. In fact, the old paradoxical problem of "multiplying 19*l.* 19*s.* 11¾*d.* by 19*l.* 19*s.* 11¾*d.*" is, as justifiably, a representation of a product as that of multiplying 3 feet by 3 feet; yet what is the *signification* of the former product? The latter happens to admit of a *conventional* interpretation—the former not. But (19*l.* 19*s.* 11¾*d.*)^{10} is not more incapable of intelligible interpretation than is the expression (3 feet)^{10}, either conventionally or absolutely and necessarily.

The remarks respecting a rectangle and a product of two factors, are so precisely the same in *character*, with those respecting a rectangular parallelopiped and a product of three factors, that it is unnecessary to say a word upon the latter subject.

Taking, then, the conventional relation between a geometrical space and a unit of the same kind, we see that for each of the cases a, ab, abc, we have a *different kind of unit*, viz. linear, superficial, and solid. This, however, implies nothing but the actual number of unit lines, unit squares, and unit cubes; whilst the geometrical construction of them implies, also, an arrangement of them in a certain manner—a particular mode of "stowing them away," if I may so speak. The product merely expresses the *number*, and does not imply any arrangement of them. In taking a geometrical view of the magnitudes generated by the successive processes, they are of *different kinds* at each step of the process. No number of geometrical lines can make a surface, and no number of geometrical surfaces can make a solid. We may, however, repeat the line a as often as there are linear units in b, and this new line as often as there are linear units in c: or, again, we may repeat ab square units as often as there are units in c. In either case abc will have a *conventional* signification; but most certainly, not a necessary signification beyond a mere numerical product, independently of this convention.

Moreover, for illustration, suppose the *unit* to be a six-inch cannon ball; then it is clear that no identity can exist between abc, as the representative of a

* Though, as my former papers will show, I am a sincere admirer of the antient geometry, I must put in a claim to exemption from being "a blind follower" of them. For instance, I deem Props. 7, 8, 9, 10, of the fifth book of Euclid to be perfectly surperfluous; inasmuch, as while the question is one of *magnitude only*, a magnitude equal to one of the equal magnitudes may be taken into consideration instead of it; and a ratio of inequality is necessarily implied in the inequality of the antecedents when compared with the same consequent. The argument is, however, not inaccurate, but superfluous—the subject is simply "overdone."

portion of space, and that of a number (abc) of these balls. They may be ranged in any way we please: but the only idea we can attach to the product is that of their number. Exchange the illustration of balls for that of six-inch cubes, and the same strictly holds good.

It must now, I think, be quite clear, that under *any view*, (even that through which the analogy is admitted to extend,) we cannot represent space by numbers, except on the ground of mere geometrical convention; and of course we can make no such convention beyond that which belongs to the fundamental conceptions of geometry itself. This necessarily limits us to the three dimensions of space.

It will, therefore, follow that the ingenious idea of TATROMATHEMATICUS is founded upon a casual analogy, rather than upon a general principle. His steps after the third (the cubes) are taken on a different hypothesis from that on which those first three were taken. His second *unit* was different *in species* from the first, and his third different from both these: but all his subsequent units are of the same species as the third itself—they are all solids, and differ *only in magnitude, not in species*. The product, abc, under any circumstances can only express the number of units in that product, of whatever kind or species the unit may be taken; and the powers of numbers may be as easily "represented" by lines, or by surfaces, as by solids. All will depend upon the convention expressed or implied in our primary hypothesis respecting the particular unit. If, however, (as is *tacitly done* in framing an analogy between a product and a rectangle,) we hypothecate some particular mode of placing the squares, or cubes; we then, and then only, are bound in our interpretation by the conditions so imposed. It is precisely the same in the application of algebra to geometry, as in its application to physics. The very act, however, of our taking the expressions, a, ab, abc as those of a line, a rectangle and a rectangular parallelopiped, absolutely precludes our using them in any sense which is incompatible with the first assumption, and the geometrical conceptions by which they are inevitably controlled. At the same time, and for the same reason, it precludes our taking more factors, as $abcd$, $abcde$, &c., as the expressions of geometrical conceptions, whilst they are all subjected to the implied law of linear units being posited in a given manner,—the supplementary operations of completing the rectangle or the parallelopiped being understood to be essentially implied.

But this implied system of the positions of the lines, and the supplementary operations, is not indigenous to algebra; and the interpretation of a numerical product is not more bound by it than by the "man-in-the-moon." If we start with the additional hypothesis, we are then, however, bound by it *throughout*. The onus then rests upon TATROMATHEMATICUS to show in *what species of unit* he considers the fourth dimension to be, what the fifth, and so on: for we have seen that for one, two, and three dimensions, as related the corresponding number of factors, the species of the unit is changed at each step of his process. Or, for the other horn of the dilemma, to show why the unit should be changed during the earlier stages, and then suddenly become of one permanent species.

In conclusion, then, the matter appears to stand thus:

1. That a numerical product only expresses a number, and can only be represented by that number without the additional or conventional hypothesis of a concrete unit.

2. That for any specific unit, a product can only express the number of times which that specific unit is repeated; and that it can never, without an additional convention, express anything else. To represent other, for instance, by $3a$, than three times the magnitude a (viewed as a geometrical one) would be to violate our fundamental geometrical principles and conceptions.

3. That the notion of *position* arising from the analogy between products and geometrical magnitudes, is simply one of *packing together* in an implied order, the actual number of units (of whatever kind they be) in a particular manner. In the paper which has given rise to these remarks, a unit-cube is repeated a times in one line; then this line of cubes is repeated b times side by side with the former; and, lastly, this stratum of cubes is repeated c times in a succession of strata similar to itself. The resulting parallelopiped is then repeated d times continuously in a line; this again

repeated *e* times, side by side as before; and then, again, this repeated in a stratified manner *f* times, as in the first case. The only conditions imposed, then, from geometrical considerations, are those of the *species of unit* and the *manner of arrangement* of the entire number of elementary cubes.

4. That under this aspect, and taking account of the implied conventions, the mode adopted by TATROMATHEMATICUS will be quite valid and correct; and that the *quantity* of space occupied by the ultimate solid is *proportional to* the corresponding powers and products of numbers. Whilst on the other hand, if it be supposed (as is usually represented) that there is a *necessary* relation between the first three powers of numbers and the combinations of length, breadth, and thickness, the process of his reasoning will become sophistical.

5. That by means of areas, or even of lines, the powers of numbers might be equally represented, provided we make the requisite conventions, as to the unit of space; and likewise that any other objects of our conception, (as, pounds sterling, hours of duration, or degrees-centigrade) might equally well represent them in the same sense. Space, however, is that which most easily represents them to our senses, and therefore to our conceptions.

Have I been too diffuse? Perhaps I have: still the subject is important, and its discussion in this form will greatly tend to shorten a discussion of a subject upon which I had entered formerly in your Magazine, and which has been only left incomplete so long in consequence of undeferrable engagements. The veneration, too, which I entertain for the personal character and high intellect of TATROMATHEMATICUS, have induced me to offer *full* reasons for differing from his views to a certain extent—or, I may more properly say, under a certain aspect in which I think them likely to be most generally understood.

The subject of the *signs* + and −, is also an important one—too important to be discussed within the limits to which I can hope for liberty to trespass on your pages in the same Number that contains the preceding discussions. It will keep another week without turning acid.

I still remain, Mr. Editor,

Your "EX-REVIEWER."

DEANE, DRAY AND DEANE'S CESS-POOL CLEANSER.—CROSSKILL'S LIQUID MANURE CART, ETC.

Sir,—I trust you will permit me to offer a few observations in reply to the letter of Mr. S. B. Milne, *Engineer*, which appeared at page 185 of your 1306th Number.

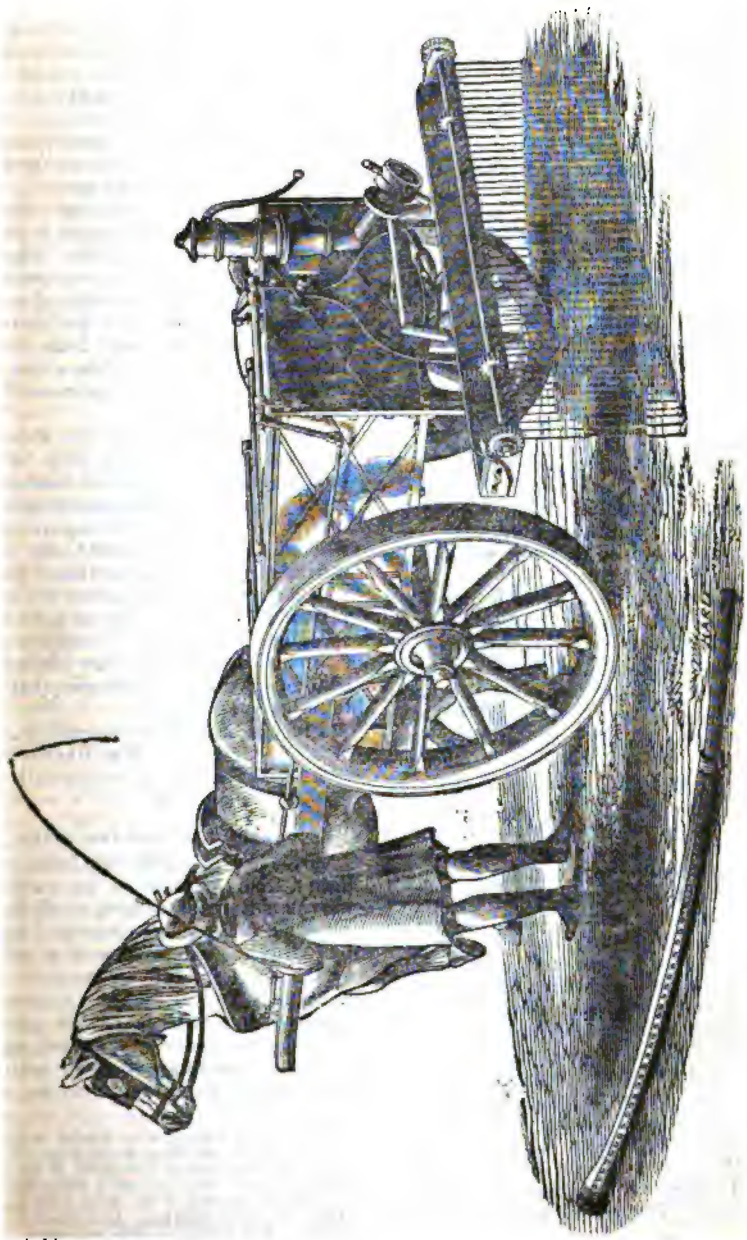
What the extent of my agricultural operations have to do with the capabilities of Messrs. Deane's and Co.'s cess-pool cleanser, or how it happens that my private affairs are so well "known to every fireman in London?" I stop not to inquire,—

> "To them we leave it to expound
> Who deal in sciences profound."

I would observe at the outset, that all the objections advanced in my two previous letters (pages 160 and 184) to Messrs. Deane, Dray and Deane's cess-pool cleanser, had reference solely to the difficulties that would inevitably attend its employment for emptying cess-pools in towns, as a proposed measure of "Sanitary Reform."

Mr. Milne tells us indeed (*à la Munchausen*) that "this cess-pool cleanser has been employed in emptying THOUSANDS" of "cess-pools, AND *water-closets!*" As the machine has not yet been completed half a thousand days, the greater part of which it has been "upon show," this statement strongly reminds me of the boy who had no desire to see that "London Annual" the Lord Mayor's show,—having seen it "hundreds of times!" I will not accuse Mr. Milne of wilfully attempting to impose upon your readers; he may have been himself most egregiously deceived—or be sadly prone to romance. His allusion to "*chaff*," is ominous. As an *agriculturist*, he probably would know nothing about *water-closets*—but as an *engineer* he should know, that water-closets invariably empty themselves—into a cess-pool it may be, or a running drain. The "*portables*" are, I believe the only exception.

Messrs. Deane, Dray and Deane are personally unknown to me, except as gentlemen in an extensive way of business. In a matter of great public importance I felt convinced they had made a mistake, or had been misled; and although not immediately, they will eventually admit the force of the objections I have pointed out.



"And be it for ever by all understood,
My censures were only pronounced for their good."

Mr. Milne, however, enters the lists as the champion of the Royal Agricultural Society of England, to defend them from "a most unjustifiable attack." I questioned the right of this Society to award a prize to Messrs. Deane and Co.'s "Cess-pool Cleanser," upon the ground, that it was *not* an agricultural implement. Mr. Milne, trickily attempts to justify the Society's award, by calling the machine a "*Farmer's Liquid-manure Cart.*" In none of Messrs. Deane and Co.'s announcements, nor in the Exhibition Catalogue of the Agricultural Society, is it so described. Neither was it so styled in the Society's award! Mr. Milne must have found himself in a pretty considerable fix, before he had recourse to so desperate an expedient as this, which places him on the other horn of a dilemma. The fact is, that Messrs. Deane and Co.'s cess-pool cleanser, although destitute of all the appendages necessary to constitute a "manure cart," is much more costly than the best and most complete of those machines.

The very excellent liquid manure carts manufactured by Mr. Richard Stratton, of Bristol, and by Mr. Crosskill of the Beverley Works, Hull, (many of which have been periodically rewarded and exhibited at the Agricultural Society's meetings,) are well known to agriculturists. Several very good machines of this kind were exhibited at the York meeting, the cost of which did not exceed the half of the price asked for Messrs. Deane and Co.'s cess-pool cleanser. If then, (according to Mr. Milne's position) the cess-pool cleanser of Messrs. Deane and Co. was rewarded by the Royal Agricultural Society as a "*liquid-manure* cart"—it must have been because it was the *most expensive*, as well as the *most incomplete* instrument of the kind exhibited at the York Meeting!!!

The liquid-manure cart of Mr. Crosskill is admirably adapted to its intended purpose. It was the subject of a prize at the Cambridge Meeting of the Royal Agricultural Society, and also at the Highland Agricultural Society of Scotland's Meeting in Edinburgh on the 4th instant.* The accompanying is a perspective view of this cart as seen at work. The body of the cart is of plate iron, securely cemented and bolted together, and holds 200 gallons. It is fitted with a brass outlet valve acted upon by an iron lever rod, with which the driver opens or closes the valve while walking by the side of the horse. At the hinder end of the cart is placed a pendulous spreading apparatus, with an adjustible sliding front, adapted to water equally upon level or uneven land, 6 feet broad-cast; the apparatus being suspended upon a central pivot with a regulating guide. The cart is also furnished with an improved apparatus for watering four rows of turnips at a time, by means of four flexible tubes, by which means dissolved bones and dilute sulphuric acid, or guano water, may be applied to the ridges or rows of any required width.

Within the body of the cart there are partitions, to prevent the surge of the liquid in passing over uneven land or bad roads. The pendulous spreading apparatus has been found a great improvement; without it, the cart would not water equally on uneven land, as when it passed over a slope or inclined surface the liquid naturally flowed to the lowest end of the spreading board. Mr. Crosskill's present liquid-manure cart fully justifies the admiration and the preference that has been bestowed upon it.

I remain, Sir, yours respectfully,
WM. BADDELEY.

29, Alfred-street, Islington, August 25, 1848.

CHEAP RAILWAYS FOR INDIA.

Sir,—The great good that India would derive from railroads in its extensive provinces is acknowledged on all hands. England, too, would be benefited thereby. But the want of money is viewed as the great impediment to their construction. The fact, that on a common tramway, the produce of the country could be transported by animal power, with great advantage both in point of time and expense, seems to be quite

* Mr. Crosskill's liquid-manure cart also obtained the Silver Medal of the Royal Agricultural Improvement Society of Ireland, at the General Meeting at Ballinasloe, 1845; the Silver Medal of the Highland and Agricultural Society of Scotland, at the Dumfries Meeting, in 1845; and also a Silver Medal at the Limerick Meeting of the Royal Irish Society, 1846. The Great Yorkshire Agricultural Society, awarded its best Prize to this Implement at the Beverley Meeting, 1845. It also obtained the prize of the North Lincolnshire Agricultural Society, at the Gainsbro' Meeting, 1845.

overlooked. In the desire to give to India the same admirable mode of transport that England enjoys, we do not stop to consider the inferior means within reach, which though they are unsuitable at home in the present day, would be a blessing to that distant country. Persons conversant with India know how wretchedly inefficient its means of transport are; but others will be astonished to learn, for instance, that the cotton of Berar is three months on its way to the sea coast, in consequence of its being conveyed only about ten miles a day by pack bullocks which move little more than a mile an hour.

India requires many railways, and some would be laid down in its vast plains, if it were shewn to the native population, that they could be made at a small cost, say 3000 rupees, or 300*l*., per mile, being about one-fiftieth of the estimated cost of one of the two projected lines which have obtained most favour with the public, and one-thirty-eighth of that of the other.

To bring the expense within the proposed limit of 300*l*. a mile, the rails must be very slight, and consequently the carriage and load very light. The cheapest rail, perhaps, would be two half tubes of iron (in shape and size like an iron pipe, one inch in diameter, slit down the middle), as much thicker than tin, as would bear a pressure on any point of treble the weight it is to bear, laid on wooden rails, with the convex side uppermost, on which a platform carriage with four grooved wheels, loaded with 200 lbs., would run. The platform, made of tough wood, with its wheels, need not weigh more than 24 lbs.; so the whole weight would be 2 cwt. bearing on four points, or 56 lbs. pressure at each point on the half tube.

A more durable rail might be made of two stretched iron wires, No. 1, supported by wooden rails; I have run a loaded carriage on a rail of this sort at a speed of 15 miles an hour for 100 yards without its ever going off the rail, except when pushed in a slanting direction. When drawn forward by a cord attached to the centre, the carriage never quitted the wires. Indeed, it is obvious, that if the cord is fixed to the exact centre, and pulled at a right angle with the carriage, it cannot have the slightest tendency to a lateral motion, the wire lines being of course perfectly straight and smooth. If the horse work at a distance from the carriage, being attached by a cord of sufficient length, any irregularity of his motion would be thereby corrected.

A temporary double rail of either kind, could be laid down on a plain in any province, where timber is not scarce, for less than the sum mentioned; five temporary cattle sheds, 20 miles apart, built after the fashion of the country, would cost 20 rupees, or 2*l*. each; 1000 rupees, or 100*l*., would build two long sheds, one at each terminus, 100 miles apart; and 400 platform carriages at 5 rupees each, would cost 2000 rupees, or 200*l*. Total cost at 300*l*. per mile, 30,000*l*., or three lacs of rupees; the interest on which, at five per cent., is 15,000 rupees per annum.

The mode of working the line would be as follows: On a railway in England a horse will draw daily 12 tons 25 miles; but an Indian horse will not do near that work; say, then, only one-third, or four tons, or 80 cwt., and that he will go only 20 miles a day, at two miles an hour; he will draw then 40 loaded platform carriages; and four other horses taking up the train successively will convey it 100 miles in five days; so that 900 miles may be traversed in 45 days instead of three months as at present. If four trains are started daily (two down and two up) 20 horses per hundred miles will be required.

The expense of working the line for the smallest amount of traffic that would pay, would be for the maintenance of twenty horses, an establishment at each terminus, wear and tear, &c. The maintaining cost of a country horse, or good tattoo,* for one year, including everything, viz., renewal, syce or groom, grain, fodder, &c., and allowing one spare horse to every ten, would not exceed 300 rupees. The annual expense then for horses would be 6000 rupees; say as much more for other expenses; to which add interest on capital sunk, 15,000 rupees, and we have a total of 27,000 rupees. Allow 200 working days, leaving out the rainy months, Sundays, and

* A tattoo will carry panier fashion 200 lbs. 20 miles in eight hours. A bullock will carry the same weight, but go only half the distance in the same time nearly; and each will make a day's journey.

native holidays, and we shall have 800 trains run in the year, and the quantity of goods carried 32,000 carriage loads, equal to the same number of bullock loads, the transport of which by pack bullocks would now cost 64,000 rupees. Here, then, is a great saving of expense on a small traffic. On a larger one the saving would be proportionably much more.

Manual labour might be advantageously employed in this way. A cooly, or common labouring man, will carry a load of 56 lbs. with ease 10 miles; he will carry *half* that load the same distance up a slight ascent. Now let a light rail be laid on an inclined plane of 1 in 100, for 200 yards; the depression at the end will be 2 yards, or 6 feet; let the level be restored by an upward incline of 1 in 10, the length of which will be 60 feet; a loaded carriage, with the cooly on it, placed on the long line, will run of itself, and stop on the short line, up which the cooly must push the load for 60, or less, feet, as the speed the carriage will have acquired, will drive it some way up. On the top he finds another descent of 200 yards; he mounts the carriage, first giving it a push, and rides 200 yards more, then pushing it up 60 feet; and so on till he performs a journey of 99 miles, of which he rides 90 and walks 9. If the load be 200 lbs., and weight of carriage 50 lbs., he will in pushing bear a weight of 25 lbs., leaving a large allowance for friction. If great speed be desirable, the cooly may increase the velocity by the use of treadles, or some other contrivance, until the speed due to the incline is acquired, namely, 15 to 30 mlies an hour, according to the state of the wind, which pace when once attained will, by the effect of gravity alone, be preserved to the end of the incline. The labour so spent will be partly or wholly compensated by the increased impetus given to the carriage, driving a good way up the short incline, and so leaving the cooly less space to walk and push. The expense of carriage would be sixpence for a cooly (a high rate of pay for one day) for the conveyance of 200 lbs. 99 miles. Quadruple this sum for all expenses, and we have 2s. as the full cost of a bullock load conveyed 99 miles—the present charge being 2 rupees, or 4s. for 100 miles. The time of transit may be in the first case 12 to 20 hours, or 5 to 8 miles an hour; but the cooly would work only from three to four hours. In the second case the average time might be six hours, or 15 to 16 miles an hour; but perhaps the cooly might require to be relieved before the end of the journey, and there would be increase of cost balanced by a saving in time.

My ideas as to the best mode of making a *very cheap* railway line and working it may not be correct—but the possibility of constructing such a line and working it profitably by animal power cannot be disputed. India has an abundance of men, horses, and bullocks, which could be employed with or without machinery, and, if need were, mules and fine donkeys could be imported from Arabia, Persia, &c., at a moderate cost. The mule thrives well in India, and is a most hardy and useful animal.

If any engineer or mechanic will prove to me, that such a line can be easily constructed by the common and unskilful native artificers of the country, out of the rough materials at hand (iron excepted, which must be sent duly fashioned from England); and worked by animal power, with or without machinery, I am ready to take his full sized patented model out to India, at my own expense and risk, and find the means of constructing the first railway there, looking for no remuneration whatever, until the profit accruing to the patentee should warrant such a disbursement. I have lived thirty-two years in India, am independent in circumstances, and my knowledge of that country warrants my offering myself as an agent to any one who has the skill (which I want) and the enterprise to make a cheap bit of line in England and work it, thereby proving the practicability of constructing a *very cheap*, *very useful*, and *sufficiently profitable* railway in India. Or if any person will construct such a model and work it to my satisfaction, I will pay the expense, within an agreed limit, and further bind myself to pay a handsome sum out of the profits accruing from the invention.

J. B. Egan.

58, Coleshill-street, Eaton-square.

P. S.—Mr. Tate, the contractor for the repair of the Grand Junction Railway, invented a machine by means of which two men conveyed themselves and four other men along the line at from 20

to 25 miles an hour; and you stated in your Magazine, 1838, p. 256, that he was of opinion that manual labour might be even cheaper than horses or steam, especially when speed was required. Here, then, is just what India wants. If one man can convey two men's weight at 20 miles an hour on a light rail, the thing India wants is done. For one cooly will convey a bullock load of 200lbs. 100 miles in five hours for sixpence. On a good traffic line with plenty of passengers, sixpence would cover all the other expenses; here then would be a saving of three-quarters of the present expense, and a gain of more than ten times the speed. By your own calculation, the expense of conveying passengers by the Greenwich Railway would be one farthing each; say two passengers weigh 200 lbs., and cost a halfpenny, double that on all expenses, we have then a penny for four miles; but the man's pay in India is one-fourth less than your estimate. This reduces it again to a farthing for four miles, or 25 farthings, or 6¼d., for 100 miles, being one-eighth of the present expense.

A NEW FORM OF CONSTRUCTION FOR SEA WALLS.

Sir,—Seeing in several recent Numbers of the *Mechanics' Magazine* the question as to the best method of constructing sea walls discussed, I am led to send you a few lines in explanation of an idea on the subject which has lately struck me.

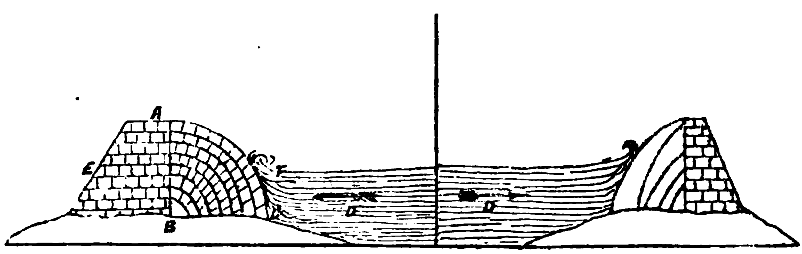
Most of the individuals mentioned in the different articles appear to be in favour of a *vertical* wall; while a few hold fast to the opinion that a *sloping* side, presented to the waves, offers the most effectual resistance.

But none seem to have hit upon the thought that a *circular convex* face may be used (I think with propriety) for the following reasons:

Every one who has studied mathematics must be acquainted with the great amount of pressure which the circle is capable of sustaining. Therefore, I propose that the face of the wall should be a circular arc (of 90°, I should prefer), as thus:

Let D, fig. 1, be the direction of the tide (supposing the current to move *hori-*

Fig. 1. Fig. 2.



zontally), and F the outward face of the breakwater, built in the arc of a circle, from A to C. First suppose the centre of this circle to be at the base B of the line AB; then the stream near the ground will reach the wall first, and being reflected at the angle of percussion, would have a tendency to fall back upon a higher stream, and thus would prevent it striking the wall with all its force.

Secondly, let the centre of the circle *not* lie on the ground, as in fig. 2; it is evident that some of the *bulk* of the erection would be taken away; and, consequently, it would require a smaller outlay in material. But these points should depend on circumstances.

Now, as to the best method of constructing such a wall, I would have the inner half built in the usual way, of

hewn stone, as far as the line AB, which should be perpendicular. When this is done, I would (fig. 1) begin at the centre of the circle, and lay a stone with a curved edge. On this I would build a series of arches, extending from the perpendicular line AB to the ground, each fixed with a key-stone, until the top of the breakwater was attained. It appears evident to me that a great amount of power would be thus obtained that would be otherwise lost, and I cannot think there would be much increase in cost over the ordinary methods of construction.

The principal advantage in building the outside part of the wall in a series of arches, would be the greater security of unfinished work against the waves, which, if it were built of horizontal layers, would be much more likely to get damaged at the time when the workmen were not able to proceed.

I am, Sir, yours, &c.,

OMEGA.

Luton, August 22, 1848.

THE SEA-WALL QUESTION.

Sir,—Will Mr. Smith be kind enough to explain the following passage, taken from his letter (page 202.) I have read it several times, and confess it appears to me to be extremely paradoxical:—

"As we know the momentum of the waves increases towards high water, let us suppose it greatest at the point where the line H. W. S. T. (*high water spring tides*) enters the front of the wall, which point we shall suppose also 10 feet below the base of the parapet or surface of the wharf; and let us also suppose this ashlar facing to be 20 feet thick from the front to the back of the wall. Now, if we take an area of one square foot upon the face of the wall, and suppose it extended to the back, it will generate a horizontal column of 20 cubic feet of stone; but each foot of this column suffers a superincumbent pressure of 10 cubic feet; therefore the pressure upon the under surface of the entire horizontal column is the weight of

$$20 \times 10 = 200 \text{ cubic feet.}$$

I might with safety take the *friction* upon a unit of surface of this material at *one-third* of the superincumbent weight, exclusive of the advantage to be derived from the cement; but I shall calculate only upon one-third, including *friction* and *cohesion*. Therefore, each square foot of area upon the upright face will give a resistance throughout the breadth of the wall equal to the weight of 226 cubic feet; and taking 13 feet of this material equal to a ton, we find that each square foot upon the face of the wall, *at the point of least resistance*, presents an opposing force to any horizontal shock equal to $20\frac{1}{2}$ tons, exclusive of the additional resistance afforded by the backing."

A wall 20 feet thick and 10 feet high has, undoubtedly, a superincumbent pressure of 200 cubic feet of masonry in every lineal foot, measured along the surface of the wall; but how (taking the weight of 13 cubic feet of stone to be equal to one ton, and the friction $=\frac{1}{3}$ of the weight) this should generate a resistance to sliding of 20·5 tons, I am at a loss to understand. The formula in that case is $P > fW$, where P = the pressure, f = the coefficient of friction, and W = the weight of the mass moved. Whence, substituting the numerical values of f and W, we have

$$P > \tfrac{1}{3} \cdot \frac{200}{13} = 5{\cdot}125 \text{ tons,}$$

and not 20·5 tons, as Mr. Smith makes it appear.

I am, Sir, yours, &c.,

WILLIAM DREDGE.

London, 10, Norfolk-street, Strand,
September 1, 1848.

MR. BOOLE'S THEORY OF THE MATHEMATICAL BASIS OF LOGIC.

Sir,—In reply to the remarks of your able correspondent, Mr. Cockle,* upon a recent tract of mine, will you permit me to say, that in the observations to which he refers, I did not intend to convey the impression that the founder of German philosophy was ignorant of the existence of a connection between hypothetical and disjunctive judgments. The single point to which my remarks were directed, was the acknowledged doctrine of Kant, that such judgments are to be referred to distinct conditions of thought—or, to use his own words, as quoted by Mr. Cockle, to distinct logical functions of the understanding,—a doctrine which, without passing any opinion upon its correctness, we may be allowed to consider as remarkable, when viewed in connection with the fact, that the expressions of those judgments can be deduced from each other by mere analytical processes. Such was the extent of my assertion. But it is

* *Mechanics' Magazine*, July 22nd, 1848.

quite possible, that my words may have seemed to convey an inference which I did not intend any reader should deduce from them.

What I meant by analytical processes may need to be explained to those to whom the subject or the method is new. As algebra is an instrument of thought, applicable to our reasonings upon number and quantity, and as its validity for this purpose ultimately depends upon the existence of such laws as the following—

$$x(y+z)=xy+xz$$
$$xy=yx.$$

these being at once laws of quantity and laws of the symbols by which quantity is represented, so is language an instrument of thought; and its fitness for this purpose depends upon its subjection to certain elementary laws, two of which are formally the same as the laws of quantity above stated, while the third is peculiar to it. We have illustrations of these laws in such examples of *equivalent expression* as the following:—

White sheep and oxen = white sheep and white oxen.

Good wise men = wise good men.

Good good men = good men.

Supposing the meaning of the terms white, good, wise, &c., to be *fixed and absolute*. If in these examples we represent the operation of the adjective by a symbol (regarding the substantive as an adjective expressive of *quality* operating upon a subject expressive of *being*,) we are presented with the following system of laws:—

$$x(y+z)=xy+xz$$
$$xy=yx$$
$$xx=x \text{ or } x^2=x.$$

These laws I have elsewhere obtained* by an independent examination of the mental conceptions. They constitute the basis of a calculus, to the general theorems of which, all forms and results of reasoning, *without any exception*, may be referred. Now, it was with reference to the processes of this calculus that the term analytical was employed. Kant appropriates the word to a different use.

The question, What essential diversities may be traced in the acts of the understanding, is one of such difficulty, that I may be pardoned for expressing a doubt whether it falls within the limits of determinate science. Without venturing to assert that Kant's solution of the question is an erroneous one, I must be permitted to express my opinion, that neither its correctness nor its sufficiency has been established. The question appears, indeed, to be one upon which some discordance of opinion may ever be expected to exist. This ought not to be thought strange. On nearly all the great problems of metaphysics, there exists more than one hypothesis, from which a consistent scheme of doctrine and of interpretation may be raised; and the foundation which Kant has laid for logic certainly falls within the domain of metaphysics. It was the design of my researches to point out certain previously unnoticed laws of thought and language—laws which, at least as phenomenal, seemed to demand a general acceptance—to show that those laws were mathematical, and to establish upon them a perfect and formal logic. This, whether or not the attempt was successful, is in itself an object strictly within the limits of exact science.

Mr. Cockle will, I am sure, pardon these digressions. To the simple discussion of the question they are unnecessary, but they may be necessary to make that discussion understood.

I am, Sir, yours, &c.,
GEORGE BOOLE.

Lincoln, Aug. 26, 1848.

* "Mathematical Analysis of Logic," p. 17. London: G. Bell.

MR. ROBERTS'S "NEW ELEMENT IN MECHANICS."

Sir,—In No. 1806 of the *Mech. Mag.* appeared under the above heading an account copied from the *Morning Chronicle* of a mechanical combination, which was brought under the notice of the British Association at their meeting at Swansea, and which it is stated "excited very great interest and was considered likely to lead to very important results." Owing to the very obscure terms of the report, and the absence of any explanatory diagram, I was for some time unable to form an idea of the arrangement; but I fancy I have at length succeeded, and that the "New Element in Mechanics" is "an old friend with a new face," and also a new name by virtue of the rite of *adult baptism*. The arrangement exhibited in the following

sketches agrees with the description given in the report as far as I can understand it, and gives the same results, and I therefore conclude it is essentially the same as that exhibited to the Association. I will describe it as nearly as possible in the words of the report, merely adding a few words which seem wanting in the original to make the meaning clear.

Fig. 1.

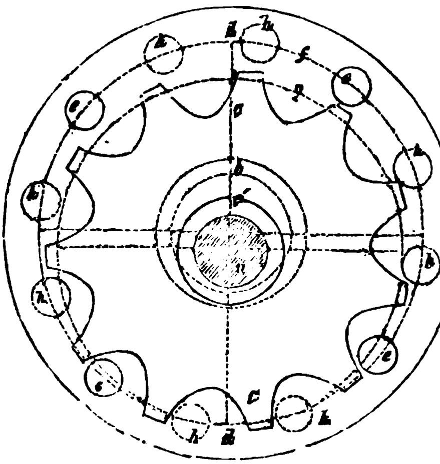


Fig. 2.

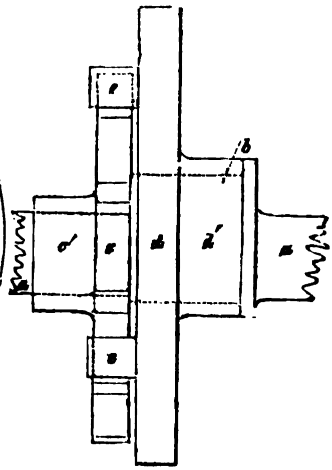


Fig. 1 is a front elevation or plan, and fig. 2 a side view; *a* is "a steel shaft," having an eccentric, *b*, formed on one portion of it. "On the shaft are fitted loosely two brass discs, *c* and *d*, having each a boss, *c′*, *d′*, to keep them steady. One of the discs, *c*, has eleven teeth in its circumference, and is placed on the body of the shaft; the other disc, *d*, which is somewhat larger, is on the eccentric *portion* of the shaft with its face to that of the toothed disc; the plain disc has four studs, *e e e e*, riveted into it at equal distances from each other, and at such distances from its centre as to admit of their being brought successively by the revolution of the eccentric to the bottom of the hollows (*or spaces between the teeth*) in the toothed disc."

A slight consideration of the diagram will suffice to show that the arrangement is simply one of a pinion working within a wheel (or trundle). The "toothed disc" is clearly a pinion, and the "plain disc having four studs," is neither more nor less than a trundle, the studs forming the staves thereof. The dotted circles, *f* and *g*, represent the pitch circles of the trundle and pinion respectively; but the real pitch,—and herein lies the source of the mystification—the real pitch, I say, is not measured by the distance from the centre of one tooth in the pinion to the centre of the next tooth, but from the centre of one stave of the trundle to the centre of the next stave; and as the pitch radii are respectively as 11 to 12, one turn of the pinion will produce $\frac{11}{12}$ of a turn of the trundle, and 1 turn of the trundle will produce $1\frac{1}{11}$ turns of the pinion, or in the words of the report, "if the shaft be held stationary and the discs be made to revolve upon it, one of the discs (*the pinion c*) will make 12 revolutions, whilst the other disc (*the trundle d*) makes 11 revolutions." If the trundle be held fast whilst the shaft is made to revolve, the motion of the pinion becomes epicycloidal, the shaft performing an orbit round the centre of the eccentric, and the pinion performining $\frac{1}{11}$th of a revolution on its axis, for each revolution of the shaft; and in like manner, should the pinion be held fast, the eccentric per-

forms an orbit round the centre of the shaft, and the trundle will advance $\frac{1}{12}$th of a revolution on its axis for each revolution of the eccentric—or, as stated in the report, if the plain disc (*the trundle*) revolve round the pinion, it will make 1 revolution on its axis during 12 revolutions round the pinion; whilst the toothed disc, (*pinion*) if it revolve round the plain disc (*the trundle*) will make 1 revolution on its axis during 11 revolutions round the plain disc. Further, to establish the identity of the arrangement with the wheel and pinion, we have only to suppose two additional pins to be inserted in the pitch circle of the plain disc, equidistant between each pair of the studs, *e e*, as shown by the dotted circles, *h h*, making 12 studs in the whole, the pitch being equal to that of the pinion, and the teeth of the latter of a suitable form, and we have evidently a wheel and pinion, whilst the effect would be the same, except that the motion would be rather more regular and equal, and the friction at the axles less.

Assuming that the arrangement exhibited in the diagrams is essentially the same as that described in your Journal, I feel equally surprised that the *invention* should have been brought under the notice of the Association, and that it should excite the interest and admiration of that distinguished body. The advantages (?) in the model, consisted merely in saving 8 pins out of 12, but with a more than proportionate increase of wear and tear; and the plan may be stated in general terms to be, the employment of the smallest possible number of teeth in a wheel with a corresponding and extravagantly coarse pitch, contrary to the rules and practice of the best authorities.

I remain, Sir, yours respectfully,

JAMES MURDOCH.

AEROSTATION.—MR. HUNT'S "GOVERNABLE BALLOON."

Sir,—In a Number of your Magazine which has reached me, I find, at page 170, a detail of an aërial locomotive proposed by your correspondent, by which it appears he is of opinion that a balloon of the ordinary construction, with the addition of a sail, nearly horizontal, and a "tail," will be governable,—that is to say, will go where the voyagers may desire. I should have thought that the question of aërial locomotion had been discussed sufficiently to show that an idea of this kind is utterly useless. Such propositions as the present, bring the subject into much disrepute; for no enterprising person would ever think of attempting to "prove them *hits*." One of the most obvious reasons why these plans are impracticable, is, that a balloon driven by the air, and in the air, cannot be steered; it will go whichever way the wind travels. Mr. Hunt evidently speaks without consideration when he remarks, that we might "make a monster machine at once, to be worked by an engine." *That* is the great question to be settled—can it be done? Are we able, in our present state of mechanical knowledge, to build a large *light* framework, yet so strong as to bear the greatest disruptive force to which it is ever likely to be subjected? Then, are we able to construct machinery sufficiently light and powerful to suit our purpose? I am one of those who think it can be effected; and if you will allow me a place in your valuable Journal, I will, as soon as my duties permit, endeavour to discuss the question, by considering what are the conditions required, for a machine or carriage to move through the air, and be governable in the air; and then, what means are at our disposal to carry out the object. The subject is undoubtedly important; and I venture to hope that the discussion to which it may lead will prove the practicability of aërial navigation. I am, Sir, yours, &c.,

G. F. W.

Upper Seymour-street, Euston-square.

Sir,—With regard to the communication of your correspondent, Mr. Edmund Hunt, as to aërial navigation, it certainly seems to me that one unfortunate stumbling-block to nearly all amateur aëronauts has hardly been sufficiently considered by him—I allude to the wind. All that he says upon this point is, "If there *is* any wind the balloon must be steered, as if going so much to windward of your destination, as the wind would carry you in the same time;" but there is a vast deal of difference between saying and doing. Will you allow me, in the first place, to ask him according to his engraving (fig. 1.) what there is to enable him to steer his balloon in any direc-

tion; and moreover in the ascent from A to B, as shown in the second figure, what exists to prevent the possibility, nay, almost certainty, of a sudden gust of wind catching the sail projecting from the middle of the balloon, sideways or underneath, so as to propel the balloon either in a contrary direction to that desired, causing it to pitch in the manner of a defective kite, and to sail through the air on its side—whereby a disarrangement of the whole machinery would be at once occasioned, and the progress of the machine to the desired destination in my opinion greatly retarded? Is it not a most undeniable fact, that even the common shaped balloon very frequently, in consequence of the wind being rather boisterous, loses its perpendicularity, and progresses with the balloon in a very slanting position; how much more likely is this to be the case when a sail is actually attached to the balloon, which, if of sufficient size to act at all, must necessarily cause the balloon to assume a horizontal posture, rendering it much more likely to pitch, and also whilst in that position rendering useless one of the sails (viz., that underneath) by its being impossible for it to act in the wished-for manner? It is true, if it were found to act in this way, were the sail capable of being furled, the balloon would again right; but then the sail on the other side would retard and render more ungovernable, rather than hasten and direct, its movements; and if that sail were also furled, the common balloon at once appears. Again, this objection, I conceive, equally applies to the figure (fig. 3) when the balloon is of a shape more likely to assist in causing this unintended position; the so-called rudder and tail, as it seems to me, in no probable way tending to prevent its doing so, or even to enable it to be replaced in the required posture when the position is thus reversed.

As respects the bold suggestion of having an engine attached for the purpose of steaming up AB and running down BC, I hardly fancy it requires comment.

In reference to the originality of the idea of the ship-shaped build of the balloon, it has long been entertained by various professors of aërostation; in fact, a short time since a gentleman (whose name I at this moment forget) residing at Hastings, constructed a machine, the account of which was in nearly all the papers, closely resembling the engraving (fig. 3) of your correspondent, although in some respects superior. Also, a friend of mine, who for many years has given his attention to this ship-shaped formation, has constructed a model of a machine which he has invented possessing the desired properties of propellation and capability of government, and in which I certainly consider he has surmounted the difficulties and objections which I cannot but conceive are apparent in your correspondent's plan.

To substantiate the authenticity of my assertion, I would furnish an engraving of the model constructed by my friend, but am not at liberty to do so, as he intends, when he possesses the necessary funds, to build a machine on a sufficiently large scale for public exhibition, and is naturally apprehensive lest the giving publicity to his invention, should enable others to forestall him in his intentions. I am, Sir, yours, &c.,

J. KELRICK.

Great Portland-street, Oxford-street.

ON THE MALADMINISTRATION OF THE CUSTOMS. BY ANDREW URE, M.D., F.R.S.

(Abridged from the *Pharmaceutical Journal.*)

By the provisions of the Sugar Bill now in force, Parliament directs the Customs to levy the duties on Sugars imported at two different rates, according to two different degrees of quality or strength—a pattern standard of white Java sugar being fixed for the higher duty, and all weaker sugar to be charged the lower duty.

It appears that Dr. H. C. Jennings submitted, about two years ago, to the Board of Customs, an instrument which he called his Saccharometer, being a floating glass hydrometer, quite similar to the ordinary saccharometer employed by distillers and brewers for taking the specific gravities of their worts. Messrs. Brande and Cooper were "desired by the Commissioners of Customs to test the correctness of the instrument in question, which according to Dr. Jennings, is calculated to indicate the quantity of crystallizable and of uncrystallizable sugar contained in the various denominations of raw or unrefined sugars usually imported into this country, it being presumed that all such sugars are essentially mixtures of the two varieties just mentioned, one of which is represented by white sugar-candy, or double-refined sugar, and the other by the purest colonial molasses." Messrs. Brande and

Cooper were provided (to use the words of the Report) "with a standard instrument, acknowledged as such both by Dr. Jennings and by the proper officers of the Customs, and they also received, through the hands of the officers of the Customs, samples of molasses and of pure sugar, and of the several denominations of colonial and other raw or unrefined sugars usually occurring in commerce, with the understanding that duplicate samples of these sugars should be retained at the Custom-house as standards of reference, in the event of any necessity arising of repeating our experiments or otherwise verifying our results." Messrs. Brande and Cooper then proceeded to determine the specific gravities of the solutions or syrups obtained by dissolving one pound of each of the other sugars in two pounds of distilled water, (the Java standard being previously dissolved in like manner), and to ascertain the corresponding indications upon the scale of the saccharometer. Messrs. Brande and Cooper next present the results of their experiments in a table republished at page 581 of the number of the *Pharmaceutical Journal* for June, 1848, and terminate their report with certain conclusions, which they think themselves justified in drawing from the general results of their experiments.

"That the composition of the different samples of raw sugar, as respects the relative quantities of crystallizable and uncrystallizable sugar which they contain, may be inferred from the specific gravities of their syrups, or solutions in given quantities of water; and that those specific gravities are conveniently shown by Dr. Jennings's saccharometer."

The following documents by gentlemen of unimpeachable truth and accuracy, prove, beyond a doubt, that the British Government and Customs have suffered themselves to be discreditably tricked out of a large sum of the public money and time, by the Jennings saccharometer—for the said instrument does not and cannot show the quantities of crystallizable and uncrystallizable sugar in different commercial samples. In fact, all sugars when equally dry, afford, *in like weights and with like quantities of water, solutions of the same specific gravity.*

Report on Jennings's Saccharometer by Mr. Long, *the eminent constructor of Saccharometers and Hydrometers, assisted by* Mr. Atlee, *Experimental Examiner of Beers, Wines and Liqueurs.*

"20, Little Tower-street, 28th March, 1848.

"Having been called upon by Dr. Jennings to make a floating glass saccharometer upon his principle, as submitted to the Board of Customs, for testing the relative strengths of raw sugars, or the relative proportion of crystalline or loaf sugar in each of them; preparatory thereto, I have in conjunction with Mr. Atlee, made the following experiments with one of my most delicate hydrometric saccharometers, such as is made use of by the Excise department, by the brewers, distillers, &c."

Table of the specific gravities of solutions of one pound of the following Sugars, in two pounds of Distilled Water at 60° Fahr., and also of the loss of weight in moisture by drying the Sugars at 212° Fahr.

Names of the Sugars.	Specific gravities of their Solutions.	Loss by weight in Water per cent.
1. White Java	1·1462	1¼
2. Brown Java	1·1449	4
3. Havanna	1·1463	3¾
4. West India	1·1463	7
5. White Bengal	1·1457	7¼
6. Crystallized Demerara	1·1460	3¾
7. Yellow Brasil	1·1455	6¾
8. Best refined loaf	1·1462	0

"It appears, therefore, that all sorts of raw sugar, when equally dried by a gentle steam-heat, and dissolved in like quantities of pure water, give like indications by the saccharometer.

(Signed) "Joseph Long.
"John Atlee.

"P.S.—The samples of sugar, 1 to 7, were furnished by Messrs. Webster, Simpson, and Scott, the sugar-brokers in Great Tower-street, and were drawn from the bulk in the Docks."

The above Report was sent to me, with the following letters:

"20, Little Tower-street, 28th March, 1848.

"Sir,—Herewith I beg to hand you the particulars of experiments made upon raw and refined sugars by Mr. Long and myself, accompanied by the solutions of the same sugars, marked Nos. 1 to 8, and shall feel obliged by your analysis of them to verify, or otherwise.

(Signed) "John Atlee.

"To Dr. Ure, 24, Bloomsbury-square."

"20, Little Tower-street, City,
4th April, 1848.

"Sir,—Since I had the pleasure on the 28th ultimo, Dr. Jennings, the recipient of the Government's bounty to the extent of 500*l.* for his improved saccharometer for determining the crystallizable properties of raw sugars, called at Mr. Long's, and in the course of conversation, we explained to

him the result of our experiments, as handed to you on the above date, the justness of which he could not controvert, and with the monosyllable 'if,' said—'if such is the fact, than my instrument is of no use after all;' and expressed himself anxious about Messrs. Brande and Cooper becoming cognizant of such result, as they had received something like 140*l.* for their report; thereby tacitly confirming the opinion that both Mr. Long and myself had heretofore entertained—that the principle as applied was a perfect fallacy; and, as a further confirmation, I have, in my inquiries at the Custom-house, ascertained that the instrument is a nullity to all intents and purposes.

"I remain, Sir, yours faithfully,

"JOHN ATLEE.

"To Dr. Ure, F.R.S., 24, Bloomsbury-square."

In accordance with Mr. Atlee's request, I took the specific gravities of his several saccharine solutions with a glass globe of 1000 water grains capacity, and a very delicate balance, and found them to be perfectly correct. That all sorts of sugar, however different in strength or quality of colour, afford solutions of equal density, is a fact well known to all skilful sugar-refiners. The following letter, addressed to me by Mr. Fairie, proprietor of the Whitechapel sugar-house, as well as of one at Liverpool, and two in Scotland, who is justly esteemed one of the most experienced, scientific, and successful sugar-refiners in the kingdom, is a decisive document upon this point. "I agree with you entirely, that the scheme of charging duty on sugar by the gravity of a solution, is *altogether absurd*, and that it ought to be exposed. I pledge myself to prove to the Surveyors-General (of the Customs) that all sugars equally dry and free from dirt, when in solution, show an equal gravity."

* * * * *

Among the vast variety of articles imported into this country, many occur which put all the resources of practical chemistry to the proof, and are quite above the sphere of any Custom-house officer. Thus, alcohol and alcoholic varnishes continue to slip in either through carelessness or connivance, notwithstanding the researches and tests published by me some years ago, in the pamphlet, entitled *The Revenue in Jeopardy*.* Singular acts of injustice are also from time to time committed by the fiscal authorities without the least indemnification. One of these, which had been thrust out of view for two years, was professionally brought before me. A cheap oil from Ceylon, with a faint cinnamon odour, was pronounced by the officials to be essence of cloves, and was rated at a duty far beyond its total value. The owner was of course obliged to ship it off to Hamburgh, where it was declared not to be essence of cloves, and whence it was transported to Holland, with no better chance of a sale, and thence back to London. A sample of it being finally sent to me for examination, it was found to be oil of cinnamon leaf; an article different in all its properties from oil of cloves, and sufficiently distinguished by one character, its specific gravity, which was only 11 above that of water, while oil of cloves is from 50 to 60. After suffering a ruinous expense and delay, the importer was further compelled by the Customs to pay my fee for the analysis.

Examples of such acts of injustice might be multiplied, and indeed they are inevitable, as the Board is at present constituted, the untaught chiefs of which, are generally hoodwinked by some presumptuous underling.

* See *Mech. Mag.*, vol. xxxviii., p. 410.

THE PATENT LAWS — REFORM OF THE PETTY BAG AND ENROLMENT-OFFICES.

One of the last Acts passed during the Session of Parliament just concluded, is intituled "An Act to regulate certain Offices in the Petty Bag in the High Court of Chancery, the Practice of the Common-Law Side of that Court, and the Enrolment-Office of the said Court." We subjoin the marginal heads of this Act, and give also some of the clauses at length which involve practical improvements of great value.

Clause 1. Abolishes after 1st January, 1849, the offices of the senior, second, and third clerks.

2. Clerk of the Petty Bag to be appointed, who is to execute his duties in person, except in case of sickness, &c., when he may appoint a deputy, with consent of the Master of the Rolls.

3. Appointment of first and other clerks of Petty Bag, who are to hold office during good behaviour, and on vacancy to be filled up by the Master of the Rolls.

4. Clerk of the Petty Bag to perform all the duties and be subject to all the regulations of the senior and other clerks, but not to be an attorney of the court.

5. Clerk of the Petty Bag not to act as attorney or solicitor.

6. Salary of clerk of Petty Bag £600, but may be increased in certain events to £800.

7. Clerk of Petty Bag may appoint such clerks to assist him as the Master of the

Rolls may direct, who shall be paid by salary.

8. Salaries and expenses to be paid out of the suitors fee fund.

9. Penalty on officers for taking gratuities, &c.

10. Power to Lord Chancellor and Master of the Rolls to regulate the transfer of business from time to time.

11. Seal of office to be provided and kept, and may be cancelled or altered from time to time.

12. Copies of documents sealed to be admissible in evidence.

13. Writs, &c., issued out of Petty Bag office to be sealed with the Chancery Common Law seal.

14. From and after the first day of January, 1849, *every* specification or instrument in writing for describing or ascertaining any invention, and to be enrolled in Chancery in pursuance of Letters Patent under the Great Seal, shall be enrolled in the Enrolment Office of the Court of Chancery; and *every* disclaimer and memorandum of alteration to be enrolled in pursuance of an Act passed in the sixth year of the reign of His late Majesty King William the Fourth, intutled *An Act to Amend the Law touching Letters Patent for Inventions*, shall also be enrolled in the said Enrolment Office, and the enrolment of every such disclaimer and memorandum of alteration in the said Enrolment Office shall be and be deemed to be the enrolment thereof in the proper office, in pursuance of the provisions of the said Act. [At present a specification, or disclaimer, or memorandum of alteration may be enrolled in any one of three different offices; and a seeker for information may have to search all three (paying fees to each) before he falls in with it.]

15. Seal to be provided for the Enrolment Office.

16. Certificates of enrolment to be given, and, when sealed, shall be admitted as evidence.

17. Every document or writing, sealed or stamped, or purporting or appearing to be sealed or stamped with the said seal of the Chancery Enrolment Office, and purporting to be a copy of any enrolment or other record, or of any other document or writing of any description whatsoever, including any drawings, maps, or plans, thereunto annexed or indorsed thereon, shall be deemed to be a true copy of such enrolment, record, document or writing, and of such drawing, map, or plan (if any) thereunto annexed, and shall, without further proof, be admissible and admitted in evidence, as well before either House of Parliament as also before any committee thereof, and also by and before all courts, tribunals, judges, justices, officers, and other persons whomsoever, in like manner and to the same extent and effect as the original enrolment, record, document, or writing, could or might be admissible or admitted in evidence, as well for the purpose of proving the contents of such enrolment, record, document, or writing, and the drawing, map, or plan (if any), thereunto annexed, and also proving such enrolment, record, document, or writing, to be an enrolment, record, document, or writing of, or belonging to the said Court of Chancery, and that such enrolment, record, document, or writing was made, acknowledged, prepared, filed, or entered on the day and at the time when the original enrolment, record, document, or writing shall purport to have been made, acknowledged, prepared, filed, or entered.

18. Punishment for forging or altering any seal or document.

19. Power to Lord Chancellor, &c., to fix a table of fees. And no fees to be taken in respect of duties performed at her Majesty's suit.

20. Clerk of petty bag to keep accounts of fees received, and pay the same into the suitors fee fund.

21. Solicitors to be entitled to practise as attorneys in the Common-Law side of Chancery.

22. Writs may be tested in term-time or in vacation.

23. Writs may be made returnable in term-time or in vacation.

24. Proceedings of the court may be in either term-time or in vacation. Any writ of scire facias for repealing, cancelling, or vacating any letters patent or charter, which shall or may at any time hereafter be issued in any action at the suit of her Majesty, hereafter to be commenced, whether at the instance of any of her Majesty's subjects or otherwise, shall or may be directed and sent to the sheriff of *any county* in *England* or *Wales*, although the record upon which such writ shall be founded or issued may be or remain in the county of *Middlesex* or any other county, and that it shall not be necessary that any such writ which at any time hereafter may be issued and directed to the sheriff of any such county as aforesaid, shall be a testatum writ, or founded upon any previous writ directed or sent to the sheriff of *Middlesex* or any other county. (At present such cases can only be tried in the county of Middlesex.)

25. Prosecutors names to be inserted in writs of scire facias.

26. Declarations, &c., in scire facias to be delivered, and not filed.

27. Pleas in scire facias to be delivered, and not filed.

28. Issues in scire facias may be tried in any of the superior courts. (At present they can be tried only in the Court of Queen's Bench.)

29. Issues upon traverses to be tried in like manner as issues in scire facias.

30. Record of issue to be filed in the office of the Petty Bag.

31. Costs to be taxed.

32. Writs and proceedings to be prepared by parties or their attorneys.

33. Judges may dispose of matters raising or incident to any action on the Common-Law side of the Court of Chancery.

34. Master of the Rolls may make orders for the custody, &c., of the records.

35. General rules and orders may be made.

36. Officers' privilege of suing abolished.

37. Proviso as to existing actions by or against officers.

38. Parties or attorneys to cause names to be entered in a book at the Petty Bag office.

39. Affidavits may be sworn before clerk of Petty Bag.

40. Saving of the jurisdiction of Lord Chancellor and Master of the Rolls.

41. Forms of writs to be settled and approved by Lord Chancellor, &c.

42. Courts of common law to take cognizance of writs.

43. Monies paid into court for her Majesty's use shall continue to be received as heretofore, &c.

44. Power to grant compensations, with consent of Treasury.

LIGHTHOUSE LIGHTS.

On the night of Thursday, the 31st ult., the Trinity Corporation exhibited two lights from the roof of their warehouse at Blackwall, both being directed towards the platform of the railway station opposite Woolwich. One was constructed according to the cata-dioptric arrangement of Mr. Alex. Gordon, C.E., which we fully described and illustrated in the *Mechanics' Magazine*, 1277, January 18, 1848; and the other was a Huddart reflector of the first water. On the platform there was a (*pro re natâ*) Board of Admiralty, composed of the Earl of Auckland, first Lord; Lord John Hay, one of the Sea Lords; and Captain W. B. Hamilton, R. N., the Secretary. There were also present—Sir J. Henry Pelly, Bart., Deputy-Master of the Trinity House, Professor Farraday, and Mr. Gordon. The two lights were precisely the same, so far as regards the kind and quantity of oil used; and, by working conjointly the axes upon which they were respectively fixed, the angles were occasionally and simultaneously shifted, so that the comparative divergence of the beams might be distinctly noted by the observers. The result showed a great difference between the values of the two lights, and was vastly in favour of Mr. Gordon's system; confirming most satisfactorily, the propriety of the preference which the Home Government has given to that system, in some colonial lighthouses which they have recently placed under Mr. Gordon's able superintendence.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Sep. 1	1561	Frederick Chas. Rein...	Strand	The lavatube, or breast reliever.
,,	1562	Winfield and Simms ...	New Bond-street	Music stand or easel.
2	1563	James Gilbert and Charles and Wm. Lancaster	Craven-buildings, Drary-lane; New Bond-street	Embossing press.
4	1564	Joseph Guise	Margaret-street, Wilmington-square	Gas burner and apparatus.
,,	1565	Joseph Hor. Cutler	Birmingham	An eye (hook and eye.)
,,	1566	Deane, Dray, & Deane,	King William-street	Stove.
,,	1567	Lane and Barkentine...	Upper Seymour-street, Euston-square	Safety buckle.
5	1568	Charles and William Lancaster	New Bond-street	Tumbler for a gun lock.
,,	1569	Robert Walter Winfield	Birmingham	Letter balance.
,,	1570	James Kimberley	Birmingham	Cramp.
,,	1571	François Perroncel & D. G. Wertheimber,	West-street, Finsbury	Artificial leech.
6	1572	Wm. Frederick White,	Brinton, Norfolk, farmer	Stack protector.
,,	1573	Hubert and Vargus ...	Margaret-street, Cavendish-square	Rivet button.

WEEKLY LIST OF NEW ENGLISH PATENTS.

George Nasmyth, of Ebury-street, Pimlico, Middlesex, civil engineer, for certain improvements in the construction of fire-proof flooring and roofing, which improvements are also applicable to the construction of viaducts, aqueducts and culverts. September 4; six months.

William Wheldon, engineer to Messrs. John Warner and Sons, of Jewin Crescent, London, brass founders and engineers, for improvements in pumps or machinery for raising or forcing fluids. September 4; six months.

John Lewis Ricardo, of Lowndes-square, Middlesex, Esq., M.P., for improvements in electric telegraphs, and in apparatus connected therewith. September 4; six months.

William Edward Hollands, of 73, Regent's Quadrant, Middlesex, dentist, and Nicholas Whitaker Green, of No. 15, Walton-place, Chelsea, gentleman, for a new manufacture of artificial fuel in blocks or lumps. September 4; four months.

William Losh, of Newcastle-upon-Tyne, for improvements in steam engines. September 4; six months.

Henry Smith, of Vulcan Works, West Bromwich, for improvements in the manufacture of railway wheels. September 5; six months.

CONTENTS OF THIS NUMBER.

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Edited by J. C. Robertson, 166, Fleet-street.

LLOYD'S PATENT BLOWING MACHINES.

Fig. 1.

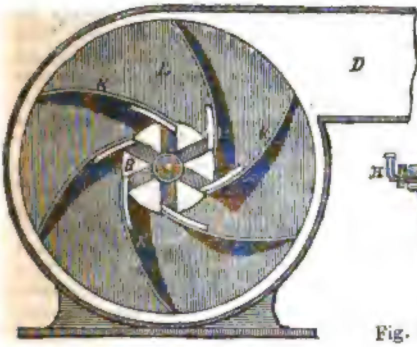


Fig. 2.

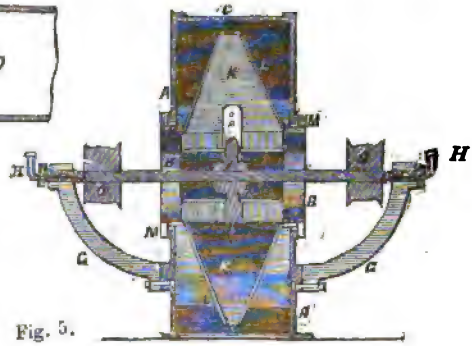
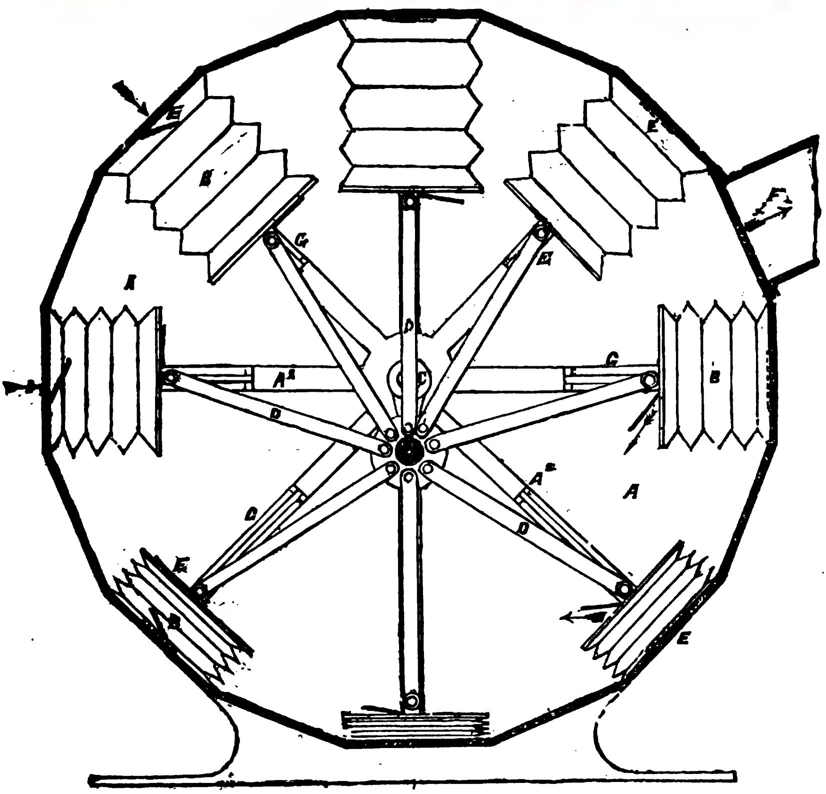


Fig. 5.



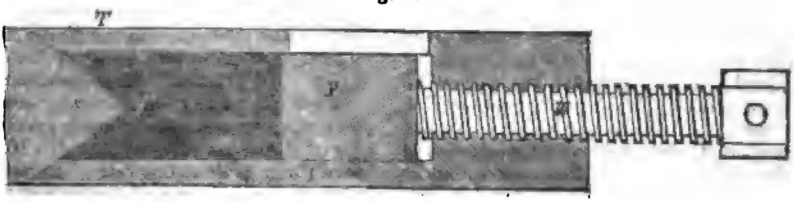
LLOYD'S PATENT BLOWING MACHINES.

[Patent dated March 8, 1848. Patentee, George Lloyd, of Stepney, Ironfounder. Specification enrolled September 8, 1848.]

The common fan-blower consists, as is well known, of a circular case, with a central hole on each side for the inflow of air, and an opening in the periphery, through which the air so admitted is expelled. A spindle passes through the central holes, and is supported in suitable bearings at the two ends. On the middle of this spindle is keyed a boss, from which project several arms, to each of which is attached a flat blade of a square form, which is made as wide as may be without touching the case. Motion is given to the blades by a strap rigger on the spindle, and connected to a steam engine or other prime mover. Now, since it is clear that the air which is drawn in at the central hole must always fall short of what is required to fill the larger space, the circumference of which is described by the tips of the blades, it follows, as Mr. Lloyd remarks, "that there must be always more or less of a vacuum formed behind each blade when revolving, and that the air which is condensed in front must rush over the ends and sides of the blades, to fill up the vacuum so formed, causing, no doubt, that disagreeable humming noise which is common to all the ordinary fan-blowers, and absorbing a large portion of the power employed for no better purpose than beating the air within the case." The object aimed at, therefore, by Mr. Lloyd in the first of two machines which he describes, is to effect the complete removal of both these great defects; and this we think he has most completely achieved.

Fig. 1 is a sectional elevation of a fan-blower embodying these improvements, and fig. 2 a transverse section through the centre of the machine. AA are the side plates, which are made with central openings, BB, as usual. C, the periphery; D, the air discharge pipe; E, a spindle, which passes through the central openings, BB, and terminates in conical ends, which revolve in the bearings, FF. I is a central boss, keyed on to the spindle, having six arms, to which as many blades, KK, are bolted, of a triangular form, and curved as shown. L is an inner casing, which encloses the blades, and is of a corresponding triangular section, with openings at the centre and in the periphery, for the admission and escape of air. MM are two rings, which are screwed on to the outer case, and encircle closely two collars, NN, which are raised on the inner case, one on each side of its central opening, but project a little way beyond the line of the outer one, so that by means of these rings and collars the two casings are joined at this part perfectly air-tight. OO are the strap riggers by which the machine is driven. The air entering the inner case by the central openings, is, by the rotation of the blades, driven out of it, through the openings in the periphery, into the outer case, and is prevented by the converging form of the inner case from reacting upon the blades (as in the common fan-blowers), and from the outer case it is expelled by the centrifugal action of the machine through the discharge pipe, D. The flow of the air, even at the greatest velocities, is uniform and steady, free from any back-lash, and almost noiseless. The total area of the openings in the periphery of the inner case must, of course, not exceed the total area of its central openings. When a very great pressure is required to be exerted at the point of emission, the openings in the peripheries of both wheels must be proportionably contracted, even in some instances to the extent of one-half the usual size. The blades, when inclosed within an inner case, such as before described, will work well at whatever radial angle they are set; but I have found in practice that they produce the greatest effect when set back at an angle of about sixty degrees, as represented in the figures. The power of the machine being in an exact ratio with the speed at which it can be driven, it is of importance that the spindle should revolve in its bearings with as little friction, and be kept as cool as possible. One mode of obtaining these objects is represented in the engraving, fig. 2. The spindle bearings, FF, consist of short cylindrical pieces screw-threaded on the outside, which are screwed fast into eye-holes in brackets, GG, attached to the outside of the outer casing of the blower. On the inner end of each bearing there is a conical socket, *s*, in which one end of the spindle revolves, and from the opposite or outer end of that bearing there is a conical hole drilled, till it penetrates by a very small aperture the bottom of the socket, *s*. H is an oil vessel with a tubular termination, bent at right angles to the body of the vessel, which termination fits into the conical hole in the outer end of the bearing piece. The vessel H, has an air-tight cap to protect it from the pressure of the atmosphere, so that none of the oil runs out, except when it is drawn

Fig. 4.



out by the rotation of the spindle, and as required for its due lubrication. Another mode of constructing the bearings of the spindles, and which I rather prefer to the preceding, is shown in fig. 4. S represents one end of the spindle, and T the bearing in which that end revolves, which consists of a hollow cylinder bevelled off at the front edges to suit the conical form of the end of the spindle. The space, y, in the cylinder immediately fronting the conical termination of the spindle, is filled with plumbago, which is pressed up against the spindle, and into the form of the spindle, by means of a plug, Y, which again is pressed forward by a screw piston, W, turned by hand. The bearing, T, may be upheld by a bracket, in the same way as before described, or in any other suitable manner.

From the preceding description, it will be seen that there are two sources from which a great saving of power may be safely predicated of this machine; first, the narrowness of the blades at their tips, which cannot be less than from one-eighth to one-twelfth of their width at the centre, whence it necessarily follows that they must offer proportionally less opposition to the escape of the air; and, second, the obstacle which the side plates or inner case present to any reflux of the air upon the blades, as in the common fan, which must be attended with a still further, and no inconsiderable saving of power.

We are told that Mr. Lloyd himself estimates that his machine will do as much work as any common fan with about one-third of the power; and, though we have not tested this estimate by calculation, we incline to think it will be found not far from the truth.

The other blowing machine described by Mr. Lloyd is of the bellows sort, and seems well adapted for all cases where a large quantity of air is required to be delivered *continuously, and at a nearly uniform pressure.*

Fig. 5 is a sectional elevation of this machine; AA are two cast-iron side frames, (one of which only is seen in the figure,) consisting each of a polygonal rim of sixteen sides, and eight arms, A^2A^3 radiating from a central boss. The rim of each frame presents in its cross section the appearance of a piece of angle iron. C is a spindle, which passes through the centres of both frames, and is cranked in the middle to nearly the same extent as the side frames are apart. BB are eight pairs of bellows, of a square form, which are attached by their outer end boards to the periphery of the frame-piece, one to every alternate side of the polygon, the boards being laid crosswise so as to embrace both rims. EE are the bellows-valves, one being in the inner end board, and the other in the outer. DD are sixteen rods for working the bellows (one half of which only are seen in the drawing,) there being two rods attached to the inner end board of each bellows, and connected at their opposite or inner extremities to a boss, H, on the cranked spindle, C. F is the general air discharge pipe; GG are guides, one on the inner face of each arm, to maintain the parallelism of the pairs of bellows when working. The spaces betwixt the arms of the side frames, as also those between the rims in the alternate sides of the polygon, are filled up with wood or sheet iron, so as to render the entire case perfectly air-tight, except where the valves, EE, and discharge pipe, F, are inserted. A door should, however, be made on each side between the arms, in order to obtain access to the bearings for the purpose of occasional lubrication. The mode in which this apparatus works is as follows:— When the cranked spindle, C, is turned (which may be done by hand power, or any other convenient means) it follows, from the varying position of the centre boss, to which the working rods, DD, are attached, that there must, in every stage of the revolution of the spindle, be some of the pairs of bellows fully distended, others only partially so, and some quite collapsed, (as exemplified in the figure,) but that each bellows must in succession be once distended and collapsed; that is, make one complete stroke. The number of pairs of bellows used may be, of course, increased or diminished according to the amount of blast required.

ON THE DIFFUSION OF SOUND.

Sir,—It is perfectly true that in our best works on acoustics we have a great deal of evidence as to the conduction of sound in various media, but still, what may be called the normal conditions of sound, that which most engages the attention of philosophers and musicians, is the generation and diffusion of sound in the atmosphere. Thus the mind is preoccupied, and less attention is paid to the other branches of the science. The vermicular and undulatory theories, and the laws of pulsation, throw very little light on those phenomena of sound, which have been very aptly likened by Faraday and others to those of electricity. The almost exclusive attention paid to atmospheric acoustics, has perhaps had a great effect in retarding the progress of acoustic mechanics. Air is one of the lowest conductors of sound; sound moves in it only at the rate of thirteen miles an hour, a rate of speed more than ten thousand times below that of light or electricity, which latter travels 300,000 miles in a minute. The mechanic, noticing this fact, is not prepared for the consideration of sound as a rapid means of communication. If a message could be sent orally from London to Liverpool, or Manchester, through the atmospheric air, it would require seventeen minutes for its transmission, in which time the electric telegraph would have carried on a long correspondence. To the furthest parts of Scotland, a lapse of three-quarters of an hour would be required for the communication. On the other hand, the human voice, if it could be adopted, would be found quicker than the electric telegraph in the delivery of a long telegraphic message. Notwithstanding this set off, the time required for the transmission of sound to long distances through the air is so great, that on the hypothesis of its being at all practicable, no mechanic would spend his time upon it. In the transmission of sound through the air, it is, however, to be observed, that the limits are greater than are generally conceived. The explosion of the meteor of 1719 was heard, when at a height of 69 miles; that of 1771 at 25, and that of 1773 at 50 miles. The meteor of 1783 was heard at an interval of ten minutes after its disappearance, which is the longest interval observed. The firing of guns at Carlscrona was heard 10 miles off; of those of Stockholm, 180 miles off; and of those in a seafight between the English and Hollanders in the North Sea in 1672, 200 miles off, being as far as Wales.—*Encyclopædia Metropolitana.*

When we apply ourselves to other phenomena, we acquire a much greater idea of the capabilities of sound. If it move through air at the rate of thirteen miles a minute, it moves through water at four times that rate, and through glass at sixteen times that rate. Thus, on the hypothesis previously assumed, the message to Liverpool would be sent in a minute and a quarter, and the message to Scotland in three minutes; periods practicably comparable with those of the electric telegraph.

We have therefore open to us, the investigation of better means for the conduction of sound, as we have accomplished those for the conduction of electricity, and acoustics may benefit from the consideration of electric phenomena. To make a comparison: hitherto sound has been treated as electricity was, when attention was absorbed in the phenomena of generation in a Leyden jar, and the means were undeveloped for its distant transmission, or its effectual action. In the beginning of the last century, from what was known of electric discharges in the atmosphere, no one could have predicated the transmission of the electric fluid by wires from Washington to Quebec. In the present day, it appears almost chimerical to propose the transmission of a spoken message many miles.

We have the means of getting high powers of conduction; the next question is, whether we can increase the limits within which the transmission of sound is now supposed to be confined? Here, again, we must put aside the laws of atmospheric acoustics, and refer to the other phenomena. Sound, like electricity, can be transmitted sensibly through solid bodies, and most certainly can be transmitted further as the conductor is better. As yet no efficient means of experiment have established the practical limits. The experiments on ice certainly prove that, under favourable conditions, sound can be transmitted a mile, or even two miles, and if not further, it is not from the want of power in sound, but from the want of mechanical facilities in the ice, from some roughness, from some breach, from some impediment, which

stops the transmission. In the experiments of Mr. Whishaw with gutta percha tubes, his efforts have been directed rather to the transmission of the breath than of the sound, and his experiments do not illustrate fully the phenomena of acoustic conduction. He has shown very beautifully, that the breath can be transmitted for a long distance so as to play a musical instrument, but this does not illustrate the acoustic conditions. Sound, being an imponderable, will travel faster than the breath, and is governed by very different laws. With all the modern experiments, and after all that has been done, this part of the subject is still in its infancy. The theoretical and the practical part will require years of labour and inquiry for their satisfactory development.

M. Biot experimented on a length of 3120 feet of iron pipe at Paris. He transmitted the breath and the slightest whisper through the inside of the pipe, and transmitted sound by the metal of the pipe, notwithstanding the joints. He made no experiment with water. Monsieur Collado, in 1826, made experiments in the conduction through water on a length of nine miles across the Lake of Geneva. The sound of a bell was distinctly transmitted. This was in free water, not in water limited by tubes.

If the question be asked, whether we have the means of establishing acoustic telegraphs, as one exemplification of the extended application of sound, a very little inquiry will satisfy us that we have. As I explained in my last, it is my object to suggest and not to experiment, and therefore I shall confine myself to a few indications of the resources at our command. In the case of Mr. Whishaw's recent inventions of the Telekouphonon and other apparatus, we have the means of effecting greater results. His gutta percha tubes conduct sound, rather on account of their mechanical smoothness and hardness, than from any other cause, but the conduction is partly effected in contact with atmospheric air. He has by this apparatus effected communications at 1300 feet apart, but if the tubes were filled with water instead of air the conduction would be very greatly augmented. With gutta percha alone we have, by means of proper applications, the power of making communications at the distance of a mile, and in all probability more. By the use of polished metals and glass, which can practically be made to comply with the required mechanical conditions, we have the apparatus for acoustic telegraphs of five miles in length by way of commencement, being under the limits of four times the Lake of Geneva experiment. Whether glass tubes within gutta percha, or water within glass tubes or within gutta percha, would be the best or cheapest apparatus, experiment must determine. Practically, I am convinced that an acoustic telegraph may be made to work between London and Liverpool.

The superior conductibility of liquids fully explains the wonderful cures of deafness which have lately been performed in America, and in this country under right of importation, by the insertion of moistened cotton in the ear. Nature has not only provided in the drum of the ear a diffusive apparatus, but has provided that the passages shall be duly moistened; and want or impediment of this by induration of the wax, is a very common mechanical cause of deafness.

While the means of conduction are within our compass, so also are the means of diffusion, which correspond to the instruments of the electric telegraph. By the adoption of proper diffusers, sound will be heard very distinctly at much greater distances than are now practicable. Whether several instruments can be established on the same conductor is an interesting subject for inquiry. So far as there are the means of judging from the present imperfect experiments, I believe there is an acoustic circuit as well as an electric circuit. Whether on a conductor of ten miles in length the establishment of a diffuser, suppose at two miles, would have the effect of hindering conduction throughout, I cannot answer fully. I believe that practically, within limits, such a degree of acoustic power can be got that several instruments can be worked by one conductor, that is, if an acoustic telegraph were established between the Exchange and the House of Commons, it would work for the intermediate stations of Doctors' Commons and the Temple. At all events, I am satisfied of this, that several lines can be worked simultaneously.

I may note here that there is no difficulty in the production of sound at a distance. The electric telegraph is made to ring bells, and electric apparatus may

be made to give out various tones. Musical sounds can readily be transmitted to great distances, but the practical object is to transmit the sound of the human voice.

For submarine telegraphs it may be noted that a water acoustic telegraph would be free from the danger to which other proposed telegraphs are liable, of the introduction of water, which would not be a disturbing cause.

It is not necessary to allude to the phenomena illustrated by Mr. Scott Russel lately, and by others at various times, under which a change of tone takes place during transmission, or as arising from the position of the speaker. In the case of the transmission of musical sounds, it would be easy to set the composition so as to produce the sound required, and the difficulty, if any, would be met.

Having taken up so much of your space, I will here bring my remarks to an end; though much might be said as to the practical mode of assisting deaf persons, of enabling a weak speaker to be heard in a large room, of supplying music to several houses, of making one speaker, singer, or musician, audible in many places at the same time, &c. It would be tempting to an opera *impresario*, to show how he might under one engagement make Jenny Lind audible in every theatre in London; but having taken up your time with the more serious parts of the subject, I must give up the lighter. I am, Sir, yours, &c.,

HYDE CLARKE.

42, Basinghall-street, Sep. 5, 1848.

ON SOME PROPERTIES OF THE BINOMIAL COEFFICIENTS. BY PROFESSOR YOUNG, BELFAST.

In a former paper in this Journal (vol. xlviii., p. 368,) I took occasion to notice the fact, that nearly all the general theorems of Analysis are nothing more than mere identities, as to value, under different forms. The present short communication is intended to show how an interesting theorem or two, respecting the coefficients of the developed binomial, may be obtained by aid of this fertile principle.

By developing the expressions $(1+x)^m$, and $(x+1)^n$, we get the following results: viz.

$$(1+x)^m = 1 + mx + \frac{m(m-1)}{2}x^2 + \frac{m(m-1)(m-2)}{2.3}x^3 + \&c.,$$

$$(x+1)^n = x^n + nx^{n-1} + \frac{n(n-1)}{2}x^{n-2} + \frac{n(n-1)(n-2)}{2.3}x^{n-3} + \&c.,$$

and if the terms which stand vertically under one another, in the right-hand members of these idendities, be multiplied together, we shall obviously get the complete term, involving x^n, which would present itself in the entire product of those two members: that is to say, this term would be

$$\left(1 + mn + \frac{m(m-1)}{2}.\frac{n(n-1)}{2} + \frac{m(m-1)(m-2)}{2.3}.\frac{n(n-1)(n-2)}{2.3} + \&c.\right)x^n.$$

This term therefore must be in value identical with that involving the same power, x^n, in the development of the product of the left-hand members; that is, in the development of $(1+x)^{m+n}$; and which term is evidently

$$\frac{(n+1)(n+2)(n+3)\ldots(n+m)}{1.2.3\ldots\ldots m}x^n.$$

It follows, therefore, that the sum of the series

$$1 + mn + \frac{m(m-1)}{2}.\frac{n(n-1)}{2} + \frac{m(m-1)(m-2)}{2.3}.\frac{n(n-1)(n-2)}{2.3} + \&c.,$$

is equal to the expression

$$\frac{(n+1)(n+2)(n+3)\ldots\ldots(n+m)}{1.2.3\ldots\ldots m} \ldots\ldots (1).$$

As the numbers m and n are symmetrically involved in the series of which this is the sum, and would therefore remain the same, though m and n were interchanged, we may write this other equivalent expression for the sum; viz.:

$$\frac{(m+1)(m+2)(m+3)\ldots\ldots(m+n)}{1.2.3\ldots\ldots n}\ldots.(2).$$

And it is not matter of indifference which of these we employ: if m exceed n, the latter form would be the more easily computed: in the contrary case, the former. If m be equal to n, then for the sum of the squares

$$1+n^2+\frac{n^2(n-1)^2}{2^2}+\frac{n^2(n-1)^2(n-2)^2}{2^2.3^2}+\&c.,$$

either expression will give

$$\frac{(n+1)(n+2)(n+3)\ldots.2n}{1.2.3\ldots.n},$$

a property which has been otherwise established by Cauchy (see "Cours d'Analyse," p. 536). It is plain, from the preceding investigation, that (2) expresses the correct sum of the series to which it refers, whether m be whole or fractional, positive or negative.

In a paper which will probably appear in the next number of the *Philosophical Magazine* (the number for October,) I have demonstrated the following general property, viz.: that the expression

$$\frac{d^n x(x-m\beta)^{m-1}}{dx^n}$$

is zero, for $x=n\beta$, provided $n \angle m$; and that it is $1.2.3\ldots.n$; for $n=m$; β being any value whatever.

From this property many interesting results, respecting the binomial coefficients, may be readily deduced. Thus, by developing the expression under the sign of differentiation, and then differentiating the resulting series once, we get

$$mx^{m-1}-(m-1)^2\ x^{m-2}m\beta+\frac{(m-1)(m-2)^2}{2}x^{m-3}(m\beta)^2-$$
$$\frac{(m-1)(m-2)(m-3)^2}{2.3}\ x^{m-4}(m\beta)^3+\&c.,$$

so that putting now β for x, we have, by the preceding theorem,

$$0=m-(m-1)^2m+\frac{(m-1)(m-2)^2}{2}m^2-\frac{(m-1)(m-2)(m-3)^2}{2.3}m^3+\&c.,$$

where m is supposed to be greater than unit.

Belfast, September 7, 1848.

FAST PRINTING PRESSES.

Sir,—I was gratified by seeing in the Number of your valued Journal for August 26, an account of Hoe's American Fast Printing Press. The principle, I perceive, is the same as that which I myself brought forward some years ago. It was adverted to in your columns. The principle in question, for which I went so far as to take out a caveat, as it is called, was communicated to the late Dr. Birkbeck, Dr. Bowring, Mr. Spottiswood, and others. The late Mr. Clowes told me he thought it would realize an unnecessary degree of speed—unnecessary in his day, but necessary now. I then thought, and think still, that if my pursuits had permitted me to attend to it—I must regret that they did not—I could have brought it before the world in an attractive form.

I proposed to employ wedge-shaped types or bevelled rules. The latter, I perceive, is the method employed by Colonel Hoe. And in place of a flat, I proposed a curved imposing table; the types being screwed up with wrenches, as indeed were resorted to in the small model which I had constructed.

As far as I can understand the description of Colonel Hoe's press, it does not seem to realise *all* the advantages of mine. I proposed to cover the *whole* surface of the printing cylinder with type; I also proposed a second printing cylinder, if the ink would bear it, and after printing the paper on one side, to print it on the other, so as to come out complete. With a little ingenuity, a folding, and if necessary, a drying machine, could be connected, so that the papers would be ready for immediate distribution.

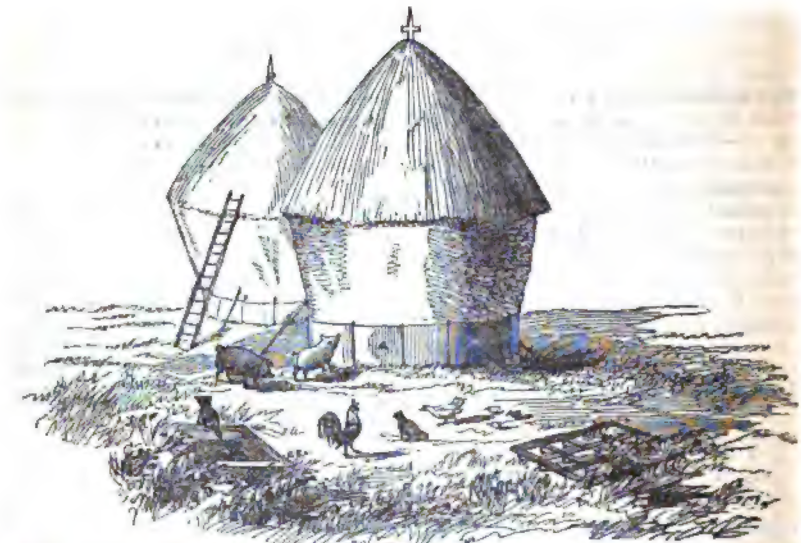
It is obvious that such a machine could be driven as fast as the materials would bear. It is equally obvious, and I thought so at the time, that this mode of fast printing must supersede all others. I am, Sir, yours, &c.,

H. M'CORMAC.

Belfast, Sept. 4, 1848.

WHITE'S STACK PROTECTOR.

[Registered under the Act for the Protection of Articles of Utility. William Frederick White, of Brinton, Norfolk, Farmer, Proprietor.]



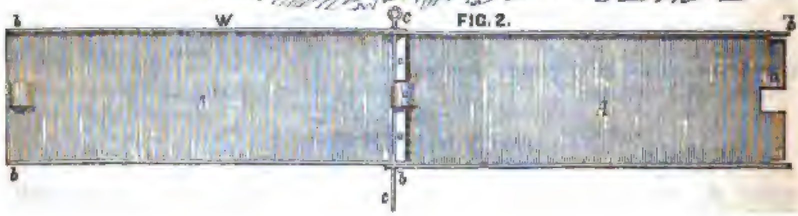


FIG. 2.

Many as the contrivances have been, for protecting the corn and hay of the farmer, from the ravages of vermin, game, fowls, pigs, &c., we do not remember to have met with anything at once so simple, efficient, and (we presume) so cheap as the present apparatus.

It consists of a number of segmental plates of zinc, or other metal, AA, which are joined together by slip-hinge joints, composed of lugs, *a a*, eyes, *b b* (which are formed out of wires, *w w*, employed to give strength to the edges of the plates, AA,) and rods, *c c*. A plan of two of these plates is given in fig. 2. The plates, when all put together, form one circular band of metal with a perfectly smooth exterior surface which vermin cannot possibly ascend.

The protector may either be put round the stack after the stack has been built, or it may be put in its place previously. The lower edges of the plates are sunk a few inches into the ground and well packed at the bottom, so as to prevent any vermin entering beneath the plates.

THE ELECTRIC TELEGRAPH.—IMPROVED MODES OF INSULATION.

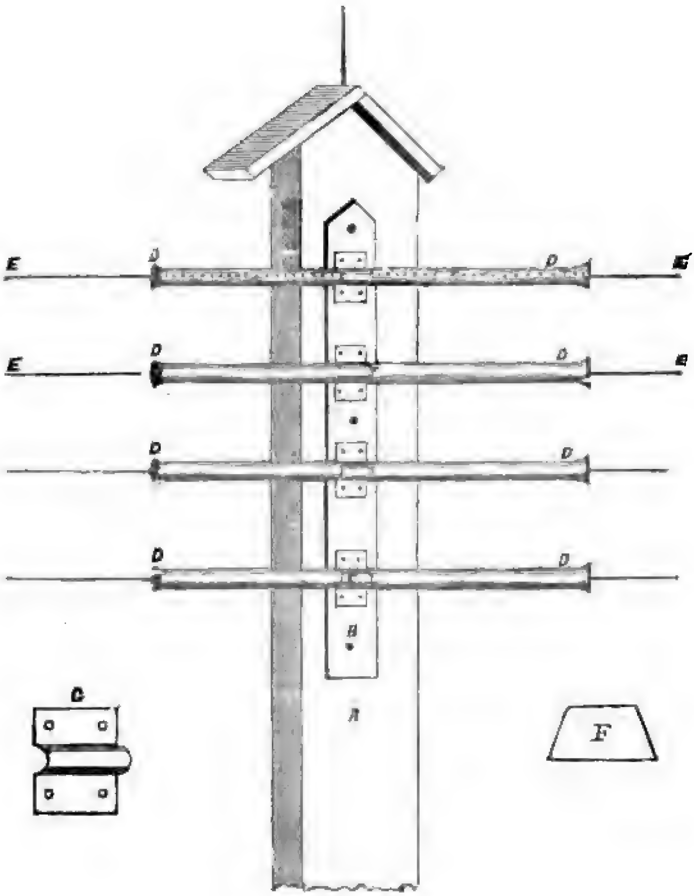
Electric Telegraph Company, Lothbury,
London, Sept. 7, 1848.

Sir,—As the advantages of the electric telegraph are daily becoming better understood, it is probable this mode of communication may ultimately be extended to most of the principal towns in

the kingdom; whatever therefore tends to improve the means of transmitting signals by the aid of electricity is likely to be beneficial to the public, as well as to the Electric Telegraph Company.

The most serious obstacle to the transmission of signals by electric action is the want of perfect insulation. I beg to submit the following plan as better adapted to obtain the desired object, than any hitherto attempted.

As a substitute for the earthenware cones at present in use for suspending the wires to the poles, I propose screwing on to the poles a piece of inch and half or other convenient-sized batten of the required length; gutta percha tubes 12 or 14 inches long, and widened into a lip at the extremities, are then strung upon the wires, and attached to the poles by a plate of zinc, shaped to the form of the cubes.



At the winding posts the bolt of the ratchet-wheel for tightening the wires is insulated by earthenware collars; I have used collars of similar form made of gutta percha, having a disk of hard wood interposed between the shoulders of the bolt and the collar to take off some part of the strain. This plan has been perfectly successful.

In towns it is necessary to lay the conducting wires under the streets; for this purpose they are placed in leaden

tubes, which are enclosed in iron pipes; but the insulation is very defective.

I propose to have any number of copper wires, covered individually with a tube of gutta percha fitting close to the wire, and either with or without a join along the sides; the latter, though rather more expensive, is doubtless the best plan. These several wires are then either bound together with a band of gutta percha, or enclosed in a tube or solid mass of the same material, which is placed in common gas pipes and laid down under the pavement in the streets, or may be used in tunnels or other places where it is inconvenient to have open wires.

I have submitted wires covered in the manner just described to the severest test, with perfect success. After keeping them in water many days, I have sent a current of electricity along them generated by 288 pairs of plates. I have used 24 cells of Grove's battery for the like purpose, and used the most delicate galvanometer to detect any contact between the wires, but the insulation has in every instance proved to be perfect.

Each of the modes of insulation above described has the further advantage of being considerably cheaper than any at present in use.

I inclose a diagram of the mode of insulation in the poles.

I am, Sir, yours, &c.,

J. H. HAMMERTON,
Supt. E. T. Comp.

Description of Engraving.

A, telegraph pole; B, batten; C, metal plate; DD, gutta percha tubes; EE, telegraph wires; F, transverse section of the batten; G, metal plate (enlarged).

EMPLOYMENT OF THE ELECTRO-MAGNETIC TELEGRAPH TO DETERMINE DIFFERENCES OF LONGITUDE.

[Extracted from the Report of the American Superintendent of Coast Survey for the year 1847.]

The use of the telegraph lines established between Washington and Jersey city, opposite New York, to obtain differences of longitude, has been continued during the present season, and the attempts to obtain differences of longitude, by this method, between Washington, Philadelphia, and Jersey city, have proved entirely successful. The arrangements explained in my report of last year were found sufficient for the continuation of the work. The superintendent of the national observatory, Lieutenant M. F. Maury, again directed the co-operation of that establishment. The observations at Philadelphia were under the direction of Professor Kendall, and those at New York under the direction of Professor Elias Loomis. The details of observation were arranged, and the connection of the different parts secured, by Assistant Sears C. Walker, of the Coast Survey, who was charged with the operation.

The principle of this method is well understood to consist in transmitting signals at a known or determined time, from one telegraph station to another, where they are noted by a time-keeper, well regulated to the time of the place. The differences in the times of giving and receiving the signals, according to the local time at each station, is their difference of longitude expressed in time.

The signals are given at one of the stations by pressing a key, which causes the closing of the circuit. This closing, it is intended, shall be simultaneous with the ticking of a clock or chronometer at the station. The circuit being closed, if the electrical wave or current takes a sensible time to propagate itself, or to pass from one station to another, the absolute time of the signals reaching the second or receiving station is sensibly different from that of making the signal at the first or giving station. A coil about the poles of a horse-shoe magnet of soft iron, forms part of the circuit through which the electrical effect is transmitted. Under its influence the soft iron becomes magnetic, attracting the soft iron bar (armature or keeper) delicately poised at a determined distance from the poles of the magnet; the movement of this keeper sets in action a local battery, which gives sufficient power to make the dots and lines constituting the Morse telegraphic signals. The click of the keeper of this temporary magnet is compared, at the receiving station, with that of a clock or chronometer; thus marking the time at which the signal, made at a known time at the giving station, is received. From this explanation, it appears that there is liability to error:—1, in the clock times at the different stations. These are easily examined and the most probable times assigned at each station, the personal equation for clock correction being determined and allowed for, they may then be treated as if only very small errors existed. 2. The time of striking the trigger or key, to close the circuit, may not coincide with the clock beat. The error, if any, from this source is determinable by experiment; and careful experiment failed to detect a sensible amount.

3. The electrical effect may take a sensible time to be transmitted, and this may be known, if other sources of error could be got rid of, by transmitting signals from an eastern to a western station, and *vice versa;* and it may be rendered null in its effect upon determinations of differences of longitude by such alternate transmission, or it may be examined in its combined effect with the next error. 4. That of the sensible interval, if any exist, between the activity of the coil, its action in inducing magnetism in the receiving magnet, and the click of the keeper of this magnet. 5. The error in noting the fraction of a second as denoted by the clock. It was perceived that this difference in the estimate of fractions of a second, rendered the transmission of signals, by the beats of a well-regulated sidereal clock, and their reception by another sidereal clock, of little avail, the time falling constantly upon the same fraction of the second. The transmission of signals, by beats of a mean solar chronometer, and the marking of the time of reception by a sidereal clock or chronometer, carries the fraction of the second over every part of the whole second, and once, at least, in ten minutes marks the coincidence of the beats of the two time-keepers. By observations of the coincidences, and the marking of intervals at the same station, the law by which each observer varied in the estimate of fractions of a second became known, and, of course, the differences (or receiving personal equations) of each observer, supposing them to be constant. Pains were taken to compare personal equations by all the observers. It turned out, finally, that this might have been done by transmitting signals; but, then, to have assumed it would have been to anticipate a result which was sought. The part of the error, then, of receiving signals from error of noting time, was ascertained numerically, and its value could be assigned within certain limits in any case. The inference is drawn from an examination of this class of personal equations, "that when the two clocks" (the one by which signals are given, and the other by which they are received, both being rated either to mean solar or to sidereal time) "do not coincide in their beats; the observers, on the average, set down the fraction of a second of the signal received too small." Of the five errors, then, which I have enumerated, the numerical values could be assigned to two, (viz.: 1 and 5,) and one (viz.: 2) was insensible. After assigning the values in any particular case to 1 and 5, there remain residual errors, caused by 3 and 4. Now, it is plain that both of these will affect the result alike; that is, will tend to make the time of receiving the signal later than it should be by the amount of retardation of the wave or current, and by the difference in the time of its reaching the spiral coil and the click of the keeper of the receiving magnet. But a comparison of the observations shows a very small residual quantity having just the opposite sign, the signal being apparently received *earlier* than it was given. From this, the nullity of both these corrections, 3 and 4, is fairly inferred, and the interesting consequences follow, that "the telegraphic method of comparing clocks, distant two hundred miles from each other, is free from error when the method of coincidence of beats is employed, and that the probable error of the longitude, from this method, is the same as the mean result of the computed relative correction of clocks for the nights of observation." An investigation of the probable value of such error shows that, under favourable astronomical circumstances, and with due care in the use of the transit instrument, "the astronomical difference of longitude, between any two stations of a trigonometrical survey, may be determined by telegraphic signals, with a degree of precision of the same order as that of the differences of latitude," the inaccuracy depending upon the same causes as the deviation of the plumb-line.

The very interesting and elaborate Report of Assistant Walker, of which I have thus given the chief conclusions, will be published with the other results of the year. It contains, in separate sections—1, a discussion of the theory of Morse's telegraph; 2, of the difficulties in the use of the telegraph, from imperfect insulation; 3, the theory of the adjustment of the magnets; 4, the theoretical discussion of the errors of the clocks at the different stations is thoroughly made, and equations of condition are formed for deducing the most probable errors from the observations; 5, equations of conditions are formed for giving the most probable difference of longitude from the observations. Under this head, the mode of giving and receiving signals is discussed; the essential character of the method of coincidences is insisted on; tables of personal equations for each observer, and each fraction of the second are framed. The key-beat and armature beat in giving signals, are found not to differ. The correction for time of transmission of electrical effect, or "circuit time," and for the armature-beats of the receiving magnet, are explained, and the whole of the physical circumstances are expressed in an algebraic form. 6. The corrections for errors of the clocks at the several stations are deduced and applied. Full tables of the observations at the several

stations are given in this connection. The corrections for the differences in noting time by the different observers, (or personal equations of clock corrections,) are next made. 7. The table of signals transmitted and received is given. 8. The results of this table are examined and compensated by the equations of condition. 9. Numerical values are assigned, from observation, to the quantities independently compared, and the consequences obtained which have been given above.

DESCRIPTION OF A METHOD OF CUTTING DRAINS FOR LAYING PIPES OR TILES. BY JAMES WHITE, ESQ., C. E.

In making drains for pipes or tiles, it is obviously of great importance that the expense should be reduced as much as possible. The first thing, then, to be thought of is, some plan for removing a deep, thin portion of earth, to get the pipes inserted, in place of cutting wide trenches sufficient for a man to stand in middle deep. Were it possible to cut slices out of the ground by steam or horse power, and of no greater breadth than necessary to receive the pipes, then draining of land might be said to have attained its highest perfection. But while trenches are made of the size mentioned, and in all sorts of soil, where the drains are three feet deep, it appears very evident that farther improvements are much wanted. I also consider it bad policy on the part of agriculturists, because there may be implements which can be made to slice out the ground upon some lands, but are not applicable to others, to consider them in a general way as things of no value.

The implement which I am about to describe, is for side-cutting drains, and it is applicable to all sorts of soil where stones do not abound. But it is neither proposed, nor would it answer, where stones abound to any great extent. Fig. 1 is an elevation of it; fig. 2, a plan; fig. 3, an end view drawn to a larger scale; and fig. 4, a portion of ground in section, showing the drain with a pipe at the bottom of it, three feet from the surface. *aa*, in figs. 1, 2, 3, represent large malleable iron wheels, half-an-inch thick to 12 inches of their diameter, and then tapering off to knife edges, as shown by fig. 3. To protect the edges from injury by stones, or hard ground, the wheels have a steel ring welded round them before the edges are beaten out, and this portion of them is hardened.

The wheels run closer at bottom than at top, as shown by fig. 3. The earth is easier removed if cut in this way than it would be were the sides of the drain cut parallel; and I conceive, the wheels will cut much better with a small jet of water playing upon them than they would do if dry; and this can be easily managed by placing a cistern upon the frame, *bb*. When the friction of the implement is greater than any motive power which can be conveniently applied, an anchor, *c*, can be let into the ground in the line of the drain, and, by having a chain from the anchor over a pulley attached to the implement, and the motive power applied at *d*, the power will be doubled. But on soils where the wheels do not penetrate to a great depth in the first instance, the implement is to be worked backwards and forwards until the required depth of cut is produced. Should this be necessary with the double power, two anchors would answer better than one, and the implement working between them. But when the motive power is applied directly to the implement, it should travel the whole length of the drain before it is brought back; and at the commencement of a drain, the wheels should be sunk up to the rollers upon their axis, before starting. If the weight of the implement is not sufficient to keep them down, they will rise of their own accord, in proportion to the hardness of the soil; but I expect that the depth which they will penetrate will be sufficient to keep them in a vertical direction; consequently, I have shown no other mode of doing it. When the implement is moved from one drain to make another, or from place to place, it is fixed upon a hurdle or low carriage, having uprights to support it; and from this hurdle or carriage it is pulled off into the pit formed to receive the wheels at the commencement of each drain.

Supposing the implement to travel at the rate of 1½ mile per hour, and that it has to pass over the ground three times to produce the required depth, and that the distance between the drains is 30 feet; then in 10 hours it would cut 18 acres of land. Presuming that this might be effected with four horses and two men, and raising the cut earth by ploughs to require a similar quantity of labour, the

expense would be vastly under the present cost of drain-making.

Having been the first patentee in England of a machine to make draining pipes and tiles by forcing clay through moulding orifices or dies, I may be allowed in justice to claim the merit of having done some good service to the agricultural interests of Great Britain.

Fig. 1.

Fig. 2.

Fig. 4.

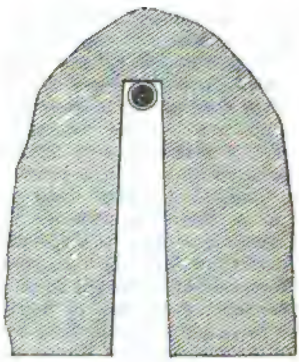
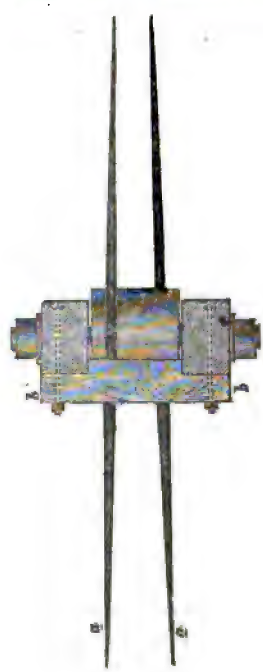


Fig. 3.



But I regret to add, that up to the present time, I have neither received honorary reward nor pecuniary benefit from the invention. My plan was first published in the *Civil Engineer and Architects' Journal*, June, 1840, and in the

following year in the *Mechanics' Magazine*, No. 953. In the former publication, pipes are recommended for draining in preference to tiles, and the mode of making them fully explained. But in the latter publication, pipe-making is not again referred to. Having met with the greatest possible discouragement for proposing to drain land by pipes,—some maintaining that the water would not get into them—others, that it was impossible by moulding orifices to make them,—I did not press the subject again on public notice. At the period referred to, there was no other machine for making draining tiles in use but the Marquis of Tweedale's; and the same parties who had undertaken to work this invention of Lord Tweedale's, bound themselves to work mine also. But with me they violated their agreement. Since then, two of them (out of three) have passed away to the world of spirits; it is, therefore, better to draw the veil of forgiveness over their faults than to write injuriously on their memories. We must all die, and can only hope to be forgiven if in our hearts we forgive others.

J. W.

Walcot-place, Kennington-road,
September 4, 1848.

THE SEA WALLS AT SHEERNESS DOCKYARD, AND SIR SAMUEL BENTHAM'S SYSTEM OF EMPLOYING BUOYANT MASSES FOR FOUNDATIONS IN DEEP WATER.

The interest which has of late been taken in the structure of sea walls, has led to recent inquiries respecting those constructed on a foundation of buoyant masses at Sheerness in the years 1811 and 1812. They were according to the plans of the late Brig.-Gen. Sir Samuel Bentham, and proof of their continued stability and efficiency has resulted from those inquiries: but as in the year 1846 the President of the Institution of Civil Engineers stated in his address to the institution, that that work had not been successful "in consequence of an unsuitable form and construction," and as condemnation of it by so eminent an engineer, can hardly fail to operate against the adoption in other instances of the invention, although the mode be so extremely economical, it seems desirable to enter at some length into particulars on the subject.

There were two different modes in which portions of the sea wall at Sheerness were executed according to Sir Samuel's plan; those two portions being under circumstances totally differing one from the other.

The first portion of wall was erected on a site above, or part of it a little below low-water mark; this first portion was built in one of the usual modes of construction, with no other than the usual precautions having been taken to ascertain the nature of the ground. In this portion cracks took place soon after its completion. The very insufficient assistance afforded in Sir Samuel's office after his removal to the Navy Board, had obliged him in this instance to confine himself to ordinary examination of the ground, instead of taking the same care he had done in this respect whilst Inspector-General of Naval Works; but before proceeding to that part of the wall intended to be in deep water, he resolved at all events to ascertain fully the nature of the subsoil. It was for this purpose he devised the cylinder described in the *Mechanics' Magazine*, No. 1300; and also a new kind of probe of large dimensions, which was weighted on a given surface, considerably beyond the weight which the ground would have to bear from any superstructure upon it.

There were persons who represented to the Lords of the Admiralty that Sir Samuel's proceedings at Sheerness were extravagant and objectionable; amongst other matters, that those frequent borings and testings of ground were productive of useless expense and delay. The Admiralty, through the Comptroller of the Navy, severely reprimanded him on this score, in consequence of which he drew up a paper pointing out the need of such examinations for all engineering works, and instancing examples of failures from the want of them; not forgetting "the part of the new wall at Sheerness according to my plans, in which, *without* frequent borings, the *crack* which has been so often mentioned and alluded to has taken place." The General proceeds thus: "In works executed by engineers, both public and private, failures of a far greater extent have taken place; in many instances, without a doubt, for want of having sufficiently ascertained the nature of the ground before the work was executed. Even that engineer so

remarkable for caution, Smeaton, had the mortification to see the bridge of ......* washed away for want of having taken his usual degree of care in examining the ground. Of course I would not be understood to say that a mere examination of the ground is sufficient to prevent failures; but what I do say is, that in executing works in any of the common modes, it is necessary to be well acquainted with the ground, before plans can be formed for erecting works upon it, with any reasonable hope of success. The various failures of the walls at Plymouth, in the Dockyard, and elsewhere—the repeated slippings out of the wall at the Ordnance wharf at Portsmouth—the failure of the new pier that is now taking place, I understand, at Margate—are instances, among many others which at the moment occur to me, of considerable failures which, probably, might all of them have been prevented in some or other of the ordinary modes of executing works of this kind, had the nature of the ground been previously well ascertained. Nay, to go so farther than the wall now building at Oreston, no doubt his Lordship will think that in this case even, time as well as money might have been saved, had the nature of the ground been ascertained and suitable precautions taken previously to the erection of the work."†

These details have been entered into in order to elucidate the *only* statement which has been found of any specific failure of any part of Sir Samuel's sea wall at Sheerness; that statement occurs in the great work of Monsieur Charles Dupin, "Voyage dans la Grande Bretagne,"‡ where it is said, "Il y a dix ou douse ans on voulut ériger un nouveau quai, pour enceindre l'Arsenal du côté de la Medway. Le Général Bentham, Inspecteur extraordinaire de la Marine, fut chargé de ce travail. A partir de la pointe septentrionale de l'ile il batit, en pierre de taille, un mur fort épais, qu'il conduisit jusqu'à l'avant bassin qui communique aux anciennes formes. Ce mur est sans talus, et sans contreforts à l'intérieur. Dans plusieurs endroits, il est déjà lézarde d'une maniére effrayante."*

From this description of the manner in which the wall was constructed, it is evident that Monsieur Dupin's statement of failure related to the part of the wall built in the usual mode, and to that part only; for it was only that part which was built as he describes the wall, that description not at all according with the part in deep water constructed by buoyant masses. The buoyant masses were *not* of *cut stone;* they were of *brick.* The masses too were *not* a *thick wall;* for although the base of each mass measured 21 feet square, the mass, instead of being a thick wall, was merely a shell of brickwork only 2 feet 3 inches thick, and was floated in that state to its place; after being sunk, the masses, it is true, were somewhat strengthened by interior brickwork, and then filled in with concrete, but this only to a certain height; the *face* of the wall to seaward, above low water, was of granite, for appearance sake. The masses and the wall above them were, as Dupin says, *upright;* for they were so made in order that ships might lie close to them for repairs and fittings, thereby doing away the need for that wasteful and costly practice of performing such works at a distance from the dockyard. The wall was still, when Dupin saw it, without buttresses or other support at the interior; for at the abolition of Sir Samuel's office, the interior supports he had intended, could not be executed until the Admiralty should have determined on his plan for the improvement of the Dockyard.

Besides the above particulars, a perusal of Monsieur Dupin's account of Sheerness Dockyard cannot fail to afford conviction that his attention had never been drawn to the new mode of structure by buoyant masses. No allusion whatever is made to it in any part of his work, although the circumstances connected with the masses were so remarkable, the depth of water in which the

* In the rough copy from which this is taken the name of the bridge does not appear.

† The first pages of this paper being missing, its date is unknown; it having been addressed to the Comptroller, it may not have been entered as a minute at the Navy Office.

‡ Paris, 1821, tom ii., pp. 234, 235.

* "It is now ten or twelve years since it was decided to construct a new quay to surround the Arsenal on the side of the Medway. General Bentham, Inspector-General of Naval Works, was charged with this work. From the northern extremity of the island, he built, in cut stone, a very thick wall, which he carried on as far as the outer basin which communicates with the old docks. This wall is without slope, and without buttresses at the interior. In many places it is already cracked in a frightful manner."

foundation was so made having been so great as from 12 to 26 feet under low water, and the soil at Sheerness notoriously a running sand, and otherwise of the worst description.

So much, for the only known evidence that is supposed to have borne against the stability of the buoyant masses. In favour of them, on the contrary, much testimony may be adduced.

In a letter to Sir Samuel, August 21, 1814, from Sir T. B. Thomson, Comptroller of the Navy, then at Chatham on his way from Sheerness, where he had been, he writes a letter, on a visitation with the Lords of the Admiralty, which ends with these all-sufficient words, "The masses stand *well*."

Soon after this Sir Samuel left England in the hope of recovering health in a warm climate, so that he only heard of the masses occasionally from friends. They said from time to time that Resident Commissioners spoke always in favour of that mode of structure, and expressed their wishes that it should be persevered in. In the autumn of 1815, the Hon. Frederick North spoke as follows to a friend of Sir Samuel's in the presence of another gentleman: "I was lately at Sheerness, and inquired of Admiral Sir Charles Rowley for the masses sunk by Sir Samuel Bentham as a foundation for a wall—I was shown the place—the wall stands perfect, and Sir Charles Rowley expressed his opinion that they completely answered." Again, May 28, 1816, (the year in which Monsieur Dupin visited the dockyard,) a friend, in speaking in his letter of the wall on masses, wrote, "I believe I had before mentioned to you that Commissioner Boyle had informed my brother that he understood it to be the intention, entirely contrary to his opinion, to take it down; but when Mr. Goodrich was in town the other day, he told me that if they ever had entertained such an intention it was now altered, for that they were determined it should remain, and had directed Rennie to complete the filling in behind it, which however he had declined to do; and then it was proposed, I believe, that it should be done under the direction of the officers of the yard, but however that had not been done, they proposing that as Mr. Heard,* had had the superintendence of the work whilst it was carrying on, he should manage the completing of it, and it is accordingly understood that orders will be, though none have as yet been, given to that effect." The letter then mentions that Mr. Rennie was continuing the wall in another, but more expensive way—that lately several of the Lords of the Admiralty had been assembled at Sheerness "to witness the laying the first stone in a part in which the water had been dammed out, which was done to the great satisfaction and admiration of every one present; but most inopportunely, just as they were about exultingly to quit the scene, in rushed the water through the dam, and buried the deposited stone."*

The masses were subjected to a variety of misrepresentations from persons at Sheerness; as, for example, Mr. Diddams, the master-shipwright of Portsmouth Dockyard, when at Sheerness in 1814, was told that the mass-built wall stood on a base of but nine feet. On coming to town he might well, as he did, express his wonder that so high a structure, 40 odd feet, could stand on a nine foot base; but he was satisfied on learning that it was really 21 feet.

From 1817 the information Sir Samuel received respecting the wall was vague and contradictory; sometimes it was said that the whole of it had been taken down; even on his return to England he could obtain no particulars till in September, 1830, he went from Chatham for a day to Sheerness, and in a short account of his excursion, written to a friend, he said, "We first called on the Commissioner (Lewis) who was very

* The Admiralty having refused Sir Samuel the assistance of a competent person as resident engineer at Sheerness, and having ordered him to carry on the great works intended there, by means of the persons in his office alone, the best he could do was to entrust the execution of the wall to Mr. Heard, a draughtsman in his office, who, though zealous and intelligent, had never had the least experience in masonry, brickwork, or any branch of practical engineering, so that the success of the masses arose from the excellence of the principle itself, seconded, it is true, by sound workmanship in their execution.

* This irruption of the water—the late accident to the dams within which the new basin at Portsmouth was constructed—and many other accidents of the same kind, evince that dams in the usual mode are far from being to be depended on; and as the influx of water in such cases inundates the whole work, whilst the mischief in case of accident to a partial dam, as described in Sir Samuel's patent, would be but partial, this circumstance indicates the expediency of giving his economical dams a fair trial, with a view to induce the use of them wherever dams may be appropriate.

civil, and immediately accompanied me about the Dockyard; very willing to afford me all information I might ask for, and to facilitate the obtainment of it; sent for the officer charged with the engineering business." After narrating matters not relevant to the sea wall, he continued, " There is a very perfect model of the Dockyard showing all the groundwork, and the thousands of piles, as also my masses, which it now appears were not, I believe, any of them, taken up, they being found so very firm; although not to appear to trust to them, a line of piling has been extended beyond them. To the ignorant multitude piles may excite respect by their complication and expense, but to those who can investigate cause and effect without prejudice, they must appear absurd, as altogether unnecessary."

This extract was recently sent to a gentleman who has been for nearly thirty years well acquainted with the works at Sheerness, requesting information as to the present state of the wall in question, and his answer was, " The masses are now in the same state of efficiency as when visited by the late Sir Samuel Bentham in 1830. No defect whatever has presented itself."

From inspection of drawings, and from further inquiry it appears that in order to render the face of Sir Samuel's sea-wall similar to that of Mr. Rennie, the latter gentleman caused a facing to be carried up in front of the wall on masses. To effect this purpose, it is believed that some of the shingle at the footing of the masses must have been removed. The masses serve, in fact, in part as the support to this facing; and the piles mentioned by Sir Samuel are to support an extension given to the bottom of it. On reference to Mr. Kingston's examination of the subsoil of this part of Sheerness, it is evident that the stability of the masses was likely to be injured by driving piles, since, in the case of their piercing the crust he describes, they would break it up, and thus destroy the natural state of the foundation.

The above seems to afford perfect evidence of the sufficiency of the masses, but should there remain a doubt on the subject, there they are at Sheerness, with the wall upon them, and they may be visited by all who take sufficient interest in sea-walls to examine the works at that port.

Many were the failures, it is well known, which after the abolition of Sir Samuel's office occurred in the progress of the works at Sheerness, and costly the measures resorted to in the repairs of them, so that the expense incurred at that Dockyard amounted, it is understood, to between three and four millions sterling: but it is only a comparison of different modes of executing a sea wall that is properly the subject of this paper.

The estimate of Messrs. Rennie and Whidby for the sea wall at Sheerness, was at the rate of 191*l.* per foot forward, no part of that wall being much below low-water, and only in one spot so much as 21 feet.

Sir Samuel, in October 1811, estimated a wall in his mode, faced above low-water with granite, at 47*l.* only per foot forward; that estimate being grounded on the actual expenditure with *all contingencies*, which had been incurred for that part of the wall already so built; the wall estimated for, being on an average of the whole, 21 feet below low-water, and at an average total height of 43 feet. The wall, therefore, by his mode, cost less than one-fourth of that estimated by Messrs. Rennie and Whidby.

It was never professed that buoyant masses were not liable to some risk in sinking them, but whatever risk there was in depositing them, arose almost entirely from the chance of bad workmanship. It happened, however, that after the great contractors, Messrs. Nicholson, Milton and Co., had witnessed the constructing and depositing of masses under Mr. Heard's superintendance, they by tender to the Navy Board offered to build wharf walling in Sir Samuel's mode at a still lower price than the above estimate: indeed so low as to have enabled Sir Samuel to estimate 5,850 feet run of walling to exterior wharf and basin at no more than 40*l.* per foot running, that wall extending depthwise 40 feet from the surface. These contractors specifically in their offer "engaged to take upon *themselves all risk and responsibility for success*." In point of time, they engaged to execute wharf walling at the rate of 200 feet running a month.

Had 5,850 feet run of walling to exterior wharf and basin been executed on a foundation of buoyant masses, it would have cost complete, no more than 234,000*l.*; but had the same length

of wall been executed as proposed by Messrs. Rennie and Whidby, it would, according to the estimate of those gentlemen, have amounted to the immense sum of 1,117,350*l.*, risk *not* included.

The difference between 234,000*l.*, and 1,117,350*l.*, or in the same proportion for any shorter length of wall, is sufficiently enormous to render mass construction, well worth consideration by engineers of the present day, seeing that an experience of thirty-six years cannot but be considered proof of the efficiency, no less than of the economy of buoyant masses for foundations in deep water.

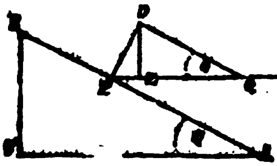
A short description of this invention was given by Sir Samuel to the Navy Board on the 15th April, 1811. He said, "I must now inform you, that the novelty of this mode consists in constructing above ground, and out of water, *distinct masses* of masonry or brickwork, of different dimensions, according to the nature of the ground and of the depth of water; and after having deposited them in the situations where they are to form a foundation, in the *pressing them into the ground*, each mass *separately*, more or less according to the quality of the ground, with a weight, or force, *greater* than what they can be supposed liable to have to bear, when the whole of the superstructure is laid upon them, and in use."

THE SEA-WALL QUESTION—VINDICATION OF CERTAIN "OBSERVATIONS ON SEA WALLS," FROM THE "REPLY" IN THE MECHANICS' MAGAZINE, VOL. XLIX., P. 234. BY T. SMITH, ESQ., C. E.

Sir,—The author of the "Reply to some Observations on Sea Walls," whose communication appears in your Number 1308, page 234, has commenced his discourse, by putting forward my opinions in such a shape, as obliges me at once to repudiate his interpretation. The only apparent object I can conceive for his having done so, was simply to lay the basis for some "small talk" which immediately after ensues, respecting "small stones completely rounded by attrition;" and also to create a most unnecessary occasion to inform your readers of the astounding fact, that such things as "massive blocks, weighing several tons, and of angular forms," have actually been used in the formation of sea embankments! But, allow me to ask your correspondent, in all sobriety, does he seriously imagine that such "small talk" will be taken by the readers of the *Mechanics' Magazine* as a "reply" to the point I have raised in page 158, namely —"That the advocates of the long sea slope are fairly called upon to show, on scientific grounds, how it was possible for materials of a certain size to have been *washed up* an incline of 18°, while materials of the same class, and subject to the same action, remained quiescent upon the lower plane of 11°, and to the same horizontal level." Now, this phenomenon is stated by Sir John Rennie to have occurred at Plymouth Breakwater (vide vol. xlviii., p. 424, 425;) and I maintain that the whole "Protest" of Sir H. Douglas is a continuous, and no doubt, a very able attempt to generalise the same doctrine, but signally fails in its object when closely analysed.

I really regret to observe so great a want of candour upon the part of your correspondent as he exhibits in the first column of page 235, where he asks, "Can he be ignorant of the fact, that a great part of the resolved forces will act perpendicularly to the general surface of the plane?" I was the first who applied the resolution of forces to this question in your valuable Magazine, page 156 (*ante*); and I am not ignorant of the distinct functions of the separate components; but I now have to complain that I should be asked such a question by a writer who does appear really ignorant of the exact nature of the resolution of forces. For this writer says, page 235, "The only part which relates to the *resolution of forces*, is in a note to article II. of the 'Protest;'" and he continues, "The weight being constant, a given impulse acting *horizontally*, exerts an effort to move the body *in the same direction*, which varies *directly* as the square of the sine of the inclination of the surface to the horizon." Now, your correspondent will, no doubt, "presume" that I err egregiously in controverting his "law;" but he must pardon me when I tell him that this "*law*" is altogether of his own making, and has no existence in nature. Let AB in the subjoined diagram be any plane, BC its height, ϕ its inclination to the horizon; then if the plane be acted

upon by a fluid in the horizontal direction QP, the whole volume of fluid which strikes the plane : BC.—



The force of the fluid upon the plane may be represented in magnitude by *any* line QP $\therefore$ take QP = BC, and, by the resolution of forces, we find DP the component perpendicular to the plane, and EP that in the horizontal direction. Let p be a particle of the fluid; then, p. sin. ϕ = the whole quantity which strikes the plane, the force of which is represented by QP; and QP. sin. $\phi = p$. sin. ϕ. sin $\phi = p$. sin^2. ϕ = PD, the portion of the force perpendicular to the plane. Again; DP. sin $\phi = p$. sin^2. ϕ. sin. $\phi = p$. sin^3. ϕ = EP, the impulse of the fluid in the *horizontal direction*. Hence,

1°. The whole quantity of fluid which strikes the plane : BC, or sin. ϕ.

2°. The force perpendicular to the plane : DP, or sin^2. ϕ.

3°. The force in the *horizontal direction* : EP, or sin^3. ϕ; *and not as sin^2 ϕ, as shown in the note appended to article II. of Sir H. Douglas's "Protest," and repeated by your correspondent, "S. S."*

It is *not* the horizontal impulse that varies as the square of the sine of inclination, but the impulse *perpendicular to the surface of the plane;* and of this important circumstance, founded upon the resolution of forces, your correspondent is unaware, while he insinuates the ignorance of others! As to the note referred to, I never could have conceived that it emanated from Sir H. Douglas, or that it formed any appendage to his "Protest;" as it is clear, that in addition to committing a fundamental error in entunciation, its author was not acquainted with the ordinary notation of mathematical science, and could not discriminate between the sin^2. θ and sin. θ^2. (*Vide* vol. xlviii., p. 564, col. 2.)

Your correspondent admits that I have rightly shown, in page 156 (*ante*), the effect of that portion of the force of a wave which is turned up the plane, and this, no doubt, is an important step gained; the only difference of opinion between us being, that he would have me "presume" that its ruinous action upon the face of the slope is indefinitely diminished by artificial means—simply to conceive the slope in its finished state, its face paved, and thenceforward "presume" it to be a philosophical abstraction. My presumption, I must say, cannot extend so far; and I need not travel out of the columns of your journal in search of ample reasons for my unwillingness. The reader is requested to turn over to pages 424, 425, vol. xlviii., and there read Sir John Rennie's account of the Plymouth Breakwater. Apart from all that is there said concerning the slope of 5 to 1, which has yet to be explained, it will be seen that, for a period of 13 years of disaster, after the commencement of the work, this all-powerful panacea of paving could not be made available, and that, as a general rule, the work can never be made sufficiently permanent for paving "until it has withstood the shock of the most violent storms." So far, then, as this remedy is concerned, we see it comes too late; but even after it was commenced at Plymouth, did the paving prove efficacious for the object contemplated? Were not all the resources of "paving," and "casing," and "bonding," and "dowelling," and "cramping," and "lewising," and "setting in cement," exhausted—not as forming part of one original, well-devised system, but as mere expedients, grasped at from time to time, as some succeeding calamity suggested them? Has not the quantity of heavy-dressed ashlar used in this patchwork system, many times doubled that which would have sufficed for an upright ashlar facing from low-water. So permanently constructed, and so durable *en masse*, as that the combined powers of the elements might vainly have assailed it? Yes, it is a noble monument of the power of mind over matter, but founded upon a wrong basis—brought to its present equivocal state of permanency at an incalculable cost to the nation, and upon principles apparently inexplicable by the most distinguished advocates of "the slope."

This writer denies that any opinion is expressed in the "Protest" concerning

the precise form which should be given to the transverse section of a breakwater. If this be so, does not a query arise as to what the "Protest" is all about? May it not fairly be said, that if this long and able document is simply confined to oppugning the opinions of others, without even suggesting a suitable substitute for that which it condemns, it is factious in its nature, and unwarrantable in its object? But the question before your readers, so far as I am concerned, is not what this "Protest" does or does not contain—but the more general and useful one respecting the best form of breakwater. In stating my views upon this subject in former communications, I passed over the "Protest" with a few general observations which appeared to bear upon the general character of the discussion; and, certainly, I never intended to return to it: but if this document is to be placed in antagonism with the *general* views I have ventured to place before your readers, then, indeed, it may be necessary for me to enter more particularly into its merits.

With respect to the appeal to the opinions of two distinguished engineers, cited by your correspondent, I have only to observe, that as those opinions have not been developed in connection with this discussion, they require no reply; and I am quite sure whatever opinions those eminent men hold could be supported by them, were it necessary, with extraordinary ability.

I am, Sir, yours, &c.,

T. Smith.

Bridgetown, Wexford, Sept. 7, 1848.

THE POTATO DISEASE—THE EFFECTS OF STEAM METEOROLOGICALLY CONSIDERED.

"We have no nostrum to recommend, we are simply explaining a fact."—*Times.*

Sir,—Permit me to occupy a small portion of your Magazine with the following remarks upon that direst scourge (the *typhus*) of the vegetable world—the POTATO DISEASE. The attention of a very large number of skilful farmers and botanists has long been directed to the elucidation of this mysterious visitation, and various insufficient reasons have, from time to time, been advanced, to account for its appearance. The most popular opinion was long, that which attributed the disease to the operations of an insect; but this notion is now pretty well exploded. No differences in the soil, situation, or mode of culture seem to offer any alleviation of the disease.

From recent observations in some of my fields, I have been led to the conclusion, firstly, That the disease is the work of a day; secondly, That it results from excess of moisture; thirdly, That it commences by fermentation and putrefaction in the stem, and is thence communicated to the root. Since possessing myself of these facts, I have seen in the *Times* of August 22nd a letter from Mr. James Cuthill, florist, of Camberwell, whose remarks, being so strikingly in accordance with the result of my own observations (as also suggestive of an apparent remedy,) I beg here to quote: "It is well known," observes Mr. Cuthill, "that no plant is so gross a feeder as the potato; that no plant contains more water in the cells than the potato; and no plant has cells so weak; in short, the whole stem is one mass of water, either rich or weak; the very roots are one mass of absorbing spongy fibres; therefore, as this is the case, if the potato be planted on a rich land, the stem is full of manure water, and, after a period of wet weather, and a sudden burst of a hot July or August sun comes across a field, it burns up what are called the 'stomates,' or breathing pores, the consequence of which is, that it stops at once the overabundant sap from being evaporated or elaborated, and immediately afterwards the whole mass of stem gets into fermentation, and the next day we see the whole field as if it had been burned; and from this moment the disease may be dated. It is just two years since I wrote a letter in the *Times*, stating that the reason why potatoes did not catch the disease under trees so severely, was on account of the poorness and dryness of the soil; the richer the soil, the more poisonous the matter when the sun burns the stomates or breathing pores of the whole plant, and the sooner it goes into a state of corruption. I have grown potatoes these nine years upon the same soil. I have these last four years not used a particle of manure but salt and soot, and I have never had the disease in my potatoes, and I am sure I never shall so long as I follow up my present practice. The sun can only cause the potato disease under very extraordinary circumstances,

such as after a period of dull wet weather, when the potato plants are in great luxuriance, and there comes what is called a close, hot, sultry day, when animals find great difficulty in breathing. From the great care taken of my sets during winter, the stems are strong and wiry from the first; and not using rank or rich manure, the stems are powerful, and the leaves not so spongy, nor full of rich matter, and, of course, less liable to injury by the sun. It is very evident that there is no cure for late potatoes, unless these sunless seasons pass away."

Sunless seasons! "ay, there's the rub;" and this naturally suggests the question, to what disturbance of ordinary meteorological equilibrium can we attribute our present "sunless seasons?" Can it be ascribed to the excess of evaporation resulting from our increased employment of steam? The amount of (hitherto unsuspected) disturbing influence thus occasioned, must, in the aggregate, be very considerable. It would be a curious, and not very difficult investigation, to ascertain pretty nearly what amount of vapour is thus annually thrown into the atmosphere, in addition to that arising from the ordinary sources of evaporation appertaining to the economy of nature. The many thousand gallons of water which are every minute given off into the atmosphere from our numerous steam boilers, cannot surely be wholly inoperative, so greatly exceeding, as that quantity in many places does, the proportion due to natural surface evaporation.

How much this may have to do with the present increasing price of our daily bread, is a matter for deep and serious reflection; the more so as any evil arising from such a source, would seem to be hopelessly irremediable.

I am, Sir, yours, &c.,

W. BADDELEY.

29, Alfred-street, Islington, August 25, 1848.

WROUGHT-IRON BOWSTRING GIRDERS FOR BRIDGES.

The above diagram represents a wrought-iron rib, or girder, now being employed in the construction of bridges, of 120 feet and 130 feet span, at Messrs. Fox, Henderson, and Co.'s establishment, the London Works, near Birmingham, under the superintendence of Mr. Joseph Locke, C.E., M.P. On the 6th instant, one of them was publicly tested at the works, in the presence of a number of scientific gentlemen and engineers. The bridge-rib had been erected, ready for proof, in an open space in front of the London Works, and presented a clear span of 120 feet between the bearings. It is constructed entirely of wrought iron, and consists of an arch of boiler plates and angle iron, tied across at the ends by horizontal bars; and the tie bars are connected with the arch by vertical standards, and by a double system of diagonals, which have the effect of distributing over the whole curve of the arch the action of weights placed on, or passing over, any point of the bridge. The proof was applied by loading the bridge-rib with 240 tons of rails, bars, &c.; and it produced the following satisfactory results, as the weight was applied:—

Weight in tons of rails, &c., placed on the cross girders.	Extreme amount of deflection produced at centre of arch.
34¼ tons	0 1-16th inches.
68½ ,,	0 5-8ths ,,
102¾ ,,	1 5-16ths ,,
137 ,,	2 1-8th ,,
171¼ ,,	2 3-4ths ,,
205½ ,,	3 5-16ths ,,
240 ,,	3 11-16ths ,,

The proof weight was fixed at 240 tons, as being double the greatest load which the bridge can by any possibility be ever required to bear. A heavy goods' train weighs less than half a ton per foot lineal; a train, consisting entirely of locomotive engines (which would be the heaviest of all possible trains) would only weight one ton per foot lineal, and, consequently, would place a load of not more than 120 tons on a bridge of 120 feet span. The new bowstring bridge has, therefore, been proved to twice the weight which ever can be placed upon it, and to four times the weight which it is ever likely to have to bear. It is scarcely necessary to add, that the trial gave great satisfaction to all parties. These ribs are adapted for large spans, in cases where either headway is of importance, or where sufficient

abutment cannot be obtained, without very heavy expense. Bridges constructed of these ribs may be employed with perfect safety for very large spans, in precisely the same manner as ordinary girders are used for small ones. The strength of the bridge depends upon the rib, or arch, and on the tie-bars by which the extremities are held together. The vertical standards are introduced, partly to suspend the load from the arch, and partly to obtain longitudinal and transverse firmness; they also support the tie-bars. The diagonals are employed for the purpose of preventing undue deflection in the rib, when the bridge is unequally loaded. The rib itself is constructed of boiler-plates and angle-iron riveted up in the form of a square hollow trunk; it is strongly tied together, so that the full section of the plates and angle-iron may be depended upon to resist the crushing strain. In order to give this trunk additional lateral stiffness, the side plates, which form the top, are made to overhang, and are strengthened on the edges by angle-iron, &c. The tie-bars measure about 8 ins. by 1 in. each, and are introduced in sufficient numbers to take the whole strain. The ribs are supported at each end on cast iron shoes, fixed at one end to the piers, and mounted at the other on sliding frames and rollers. This arrangement provides, not only for expansion and contraction, but also for motion under a very heavy load. The action of these parts under proof has been found to be perfect. Cross girders, constructed entirely of wrought iron, are suspended between the ribs. Besides the above experiments, the two ribs for a bridge, 130 feet span, have been proved with a weight of 260 tons—*i. e.*, 2 tons per foot lineal—each, put on in dead weight, by suspending cast iron cross girders underneath the points where the wrought iron girders are intended to be attached, and by placing thereon 260 tons of rails, pigs, bars, &c. In proving, the load was first put on two points at one end, then on the next two points, and so on, in order to produce, as nearly as possible the same effect as the passage of a heavily loaded train. In the case of one rib, the load was allowed to remain for several days, and then removed. After the lapse of a few days, the same load was replaced, and again allowed to remain some days. The results were very satisfactory.

During the process of proving, observations were taken with a dumpy level, placed at a distance; and the sinking of the bearing plates in the ground was observed and noted. The bridges now being constructed, are intended to carry a double line of rails; and the test applied is, therefore, equal to two tons to each foot lineal of single line of way. This test was fixed upon in the belief that the greatest possible load which can in working be placed upon each line of rails is about one ton per foot lineal; and that, to provide for the additional strain caused by the rapid motion, &c., of the practical load of trains passing, the proofweight ought to be fixed at double the greatest possible load. In very large spans (say 400 feet and upwards) it would be necessary, on many accounts, to use four ribs instead of two, and to brace all the four ribs together overhead, so as to obtain additional transverse stiffness. —*Mining Journal.*

CORRECTION OF AN ERROR IN MR. SMITH'S PAPER, P. 202.

Sir,—It is clear from the extract given in your last Number by Mr. Dredge that an error exists in the arithmetical result given in a former communication of mine; and I therefore beg to thank your correspondent for his correction.

The inequation given by Mr. Dredge rightly shows the expression. My result should have been

$$\frac{266{\cdot}66}{4 \times 13} = 5{\cdot}128 \text{ tons},$$

as shown by his corrections; and this is really the amount of resistance aimed at in my calculation. I am, Sir, yours, &c.,

T. SMITH.

Sept. 11, 1848.

ROCHAZ'S IMPROVEMENTS IN THE MANUFACTURE OF OXIDE OF ZINC.

[Patent dated December 22, 1847. Specification enrolled June 22, 1848. Patentee, C. A. F. Rochaz, of Paris.]

The patentee states, that by this improved process, the employment of retorts, as by the old method, is dispensed with, the fuel and labour greatly economised, the operation completely independent of the skill of the workman, and the loss of metal, incidental to the old method, prevented. Ores of lead and zinc may be operated on at once. The principal feature consists in the reduction of the native sulphuret of zinc (blende), and of the carbonates, oxides, and silicates of zinc, and sulphurets and oxides of lead, by the action of the reducing gases of a blast-furnace, by which the scoria, or slag, is fused, and the zinc volatilised; the vapours are then condensed, and conducted into a reservoir, situated over the mouth of the furnace, and heated by the gases therefrom. The furnace having been heated to the required temperature by the combustion of fuel alone, a charge of any kind of the above zinc ores, mixed with a suitable flux, is introduced into the charging aperture, and, by means of a cover above, and a sliding plate below, none of the gases are allowed to escape. The charge thus falls upon a layer of incandescent fuel; the layer of fuel is then poured upon the ore; then another charge of ore, until the furnace is full, and it is to be replenished as the charge sinks below a certain depth. The zinc is thus volatilised by the heat, and the scoria falls into the lower part of the furnace; the gases and volatilised zinc pass through proper openings through a hydraulic main, and there deposit any zinc carried with them.—*Mining Journal.*

WEEKLY LIST OF NEW ENGLISH PATENTS.

(One only Sealed this Week.)

William Dickinson, of Blackburn, Lancaster, machine maker, for certain improvements in, and applicable to looms for weaving. September 11; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Sept. 7	1574	John Callcott	Roehampton-street, Vauxhall Bridge-road	Rolling valve brass wind instrument.
,,	1575	William Crane Wilkins	Long-acre	Pressure lamp.
9	1576	Wm. Proctor Stanley	Peterborough, ironmonger	Rolling mill for crushing grain, seeds, and chemicals.
,,	1577	Jonathan Ashby	Greenwich, engineer	Screw friction clutch.
11	1578	Wm. Campbell Sleigh	Brick-court, Temple	L'agraffe facile (clasp).
,,	1579	Sandford and Owen	Phœnix Works, Rotherham	Portable apparatus for steaming food for cattle.
12	1580	David Hesse	Manchester	Combination neck-tie.
,,	1581	Brown and Jackson	Derby, Engineers	A mill.
13	1582	Griffiths and Hopkins	Birmingham	Nozzle for candlesticks.
,,	1583	Thos. Horton James	Bucklersbury	Chopping knife.
,,	1584	Burgess and Cooper	Crosby-row, Walworth	A pair of overalls.
14	1585	Ferguson, Miller, and Co.	Glasgow	Chimney top.

CONTENTS OF THIS NUMBER.

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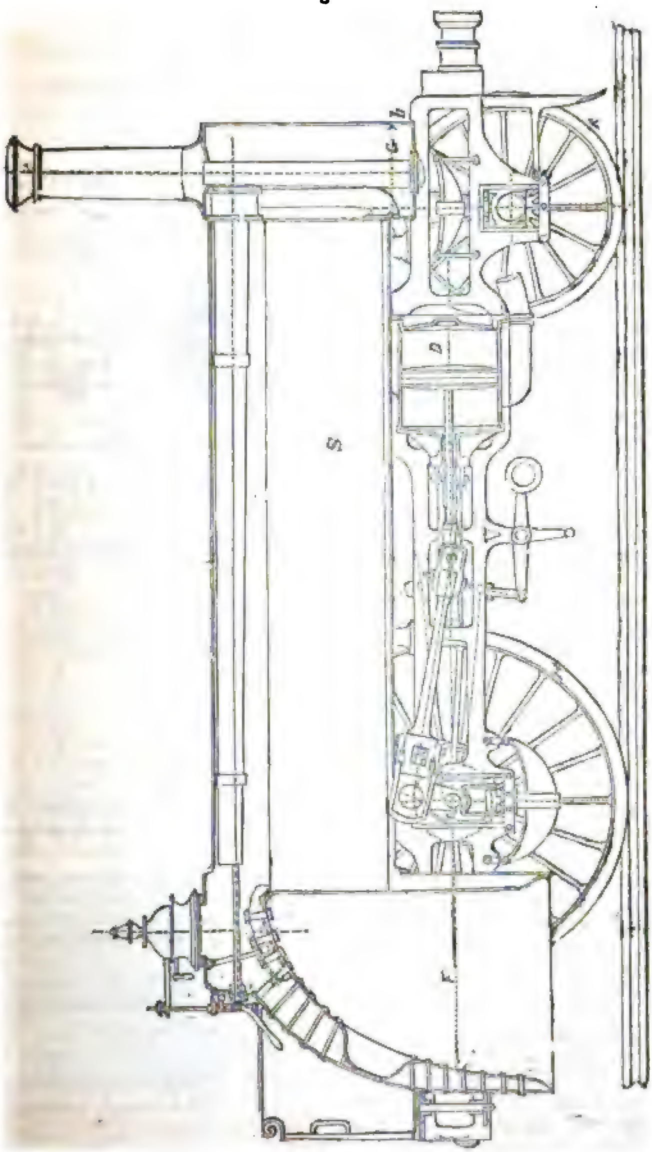
Edited by J. C. Robertson, 166, Fleet-street.

MESSRS. M'CONOCHIE AND CLAUDE'S PATENT LOCOMOTIVE ENGINE.

Fig. 1.



MESSRS. M'CONOCHIE AND CLAUDE'S PATENT LOCOMOTIVE ENGINE, WITH INSIDE WHEELS AND OUTSIDE FEED-PUMPS AND VALVE-GEARING.

[Patent dated March 8, 1848. Specification enrolled September 8, 1848.]

THE main parts of this engine are much the same as those of other inside cylinder locomotives, but with the important difference of being infinitely better arranged. The results of this improved arrangement are, 1st. That the cylinders are considerably enlarged without involving any addition to the width of the engine—an acknowledged desideratum on all narrow gauge lines; 2nd. That the working parts can be more readily got at for purposes of cleansing and repair; and, 3rd. That the centre of effort is brought more in coincidence with the centre of gravity of the machine, and that, consequently, the tendency to oscillation (so much complained of in the narrow-gauge engines when running at high velocities,) is greatly diminished, if not altogether obviated.

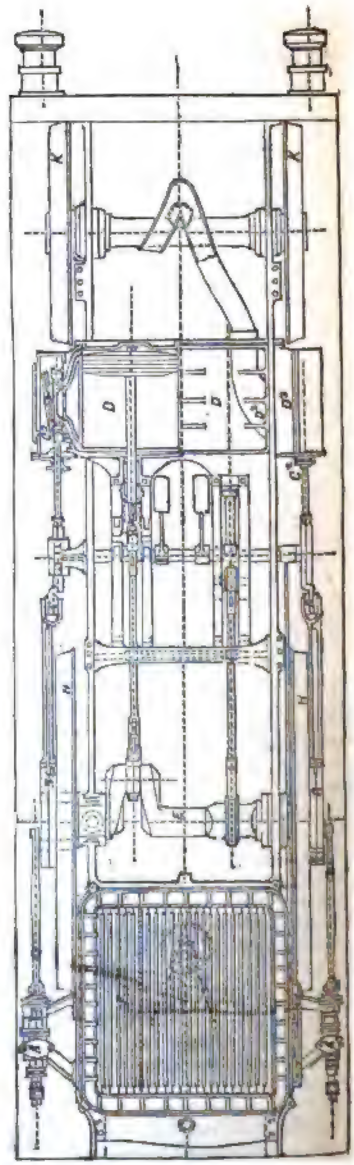
Fig. 1 is a longitudinal section, and fig. 2 a plan, on the line *ab* of fig. 1, of a locomotive engine embodying these improvements.

DD are the cylinders, which are placed, wholly or partially, behind the centre of the leading wheels, KK, in the space under the barrel, S, of the boiler, between the fire-box, F, and the smoke-box, G. The cylinders are securely bolted to the framework of the carriage by flanges, D^2D^2; and the valve-facings project through openings left in the frame (see fig. 2.) E is the crank-shaft, which is placed beneath the barrel of the boiler; AA are the feed-pumps, which are fixed outside of the driving-wheels, HH. BB are the eccentrics, which are fixed upon the crank-shaft or nave of the driving-wheel, also outside the line of both sets of wheels. CC are the rods and levers by which movement from the eccentrics is communicated to the slide-valves, C^2C^2.

From this brief description, it will be seen that the way in which the space is gained for the enlargement of the boiler, is the employment of a cranked axle, carried underneath the barrel of the boiler, and the placing of the feed-pumps and valve gearing outside the wheels.

But, besides these novelties in point of arrangement, Messrs. M'Conochie and Claude describe several substantive improvements in parts of the engine, such as the fire-box, the slide-valves, &c.: but the latter we must reserve for a future notice.

Fig. 2.



GEOMETRY OF THE LINE AND PLANE.—BY T. S. DAVIES, F.R.S., L. AND E., F.S.A., ROYAL MILITARY ACADEMY, WOOLWICH.

(Continued from page 83.)

Prop. XLIII.

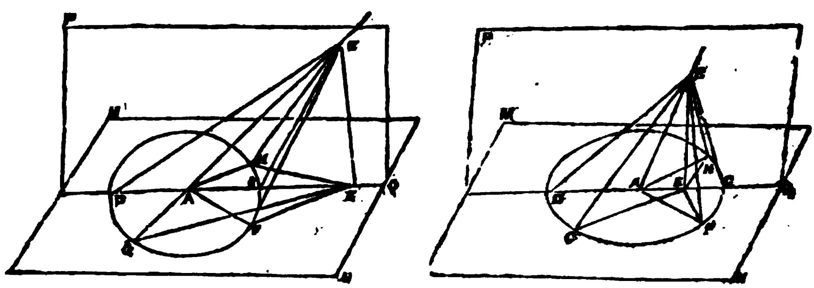
If a line be inclined to a plane, and about the point in which it meets the plane as a centre a circle be described on that plane, and if from any fixed point in the line a line be drawn to the circumference, the following relations will subsist:—

(1.) *The least is that drawn to the intersection of the acute profile trace with the circle; and the greatest is that drawn to the corresponding intersection of obtuse profile trace with the circle.*

(2.) *That which meets the circle at the greater circular distance from intersection of the circle with the profile trace will be greater than that which meets it at the less.*

(3.) *Only two such lines can be drawn equal to each other.*

(4.) *The less line makes a greater angle with the plane than the greater does; and the equal lines make equal angles.*



(1.) Let the line AB be inclined to the plane MN and meet it in A; about A describe any circle CFD in the plane MN, and let it cut the profile trace of AB in C and D, (AC being the acute profile trace): then BC, drawn from any point B in AB, will be the least; and BD, drawn from the same point B, will be the greatest of all the lines drawn from B to the circle.

For draw BE in the profile plane PQ perpendicular to CD; and draw the line BF to any other point, F, in the circumference, and join EF.

Then, EB is perpendicular to MN (*prop.* 32.) Also EC is the least line from E to the circumference, ED the greatest, and EF of some intermediate magnitude (*Euc. iii.*, 7, 8). Whence it follows that BC is the least, BD the greatest, and BF intermediate to them, of all the lines drawn from B to the circle. (*prop.* 28.)

(2.) Let the circular distance CG be greater than CF, then BG will be greater than BF.

For join FE, GE. Then EG is greater than EF (*Euc. iii.*, 7, 8.) Whence BG is greater than BF (*prop.* 28.)

(3.) Make the circular distance CH in the opposite direction equal to CF, and join BH.

Then EH is equal to EF (*Euc. iii.*, 7, 8); and hence BH is equal to BE (*prop.* 28.)

(4.) The less line BF makes a greater angle with the plane MN than the greater line BG does; that is, the angle BFE is greater than BGE; and the equal lines BF, BH, make equal angles BFE, BHE with the plane MN.

These follow from *prop.* 28, *cor.* 3, combined with what has been shown above.

Scholium.

These properties might have been enunciated with respect to edges of a cone whose base is DFC and vertex A.

Prop. XLIV.

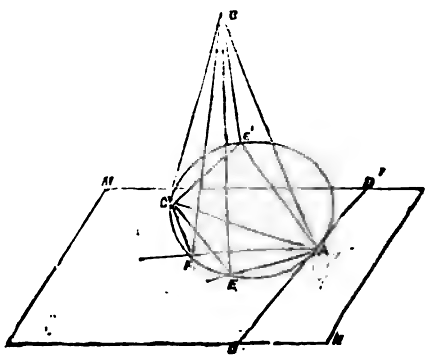
If a line be inclined to a plane, and another plane be revolved about the line to meet the plane, of all the dihedral angles formed by these planes :—

(1.) *That formed when the trace of the revolving plane is perpendicular to the line itself is the least ;*

(2.) *The dihedral angles increase in magnitude as the trace of the revolving plane makes a greater angle with the trace mentioned in the preceding case ; till it becomes perpendicular to that trace—on whichever side of the profile trace of the given line, the trace of the revolving plane be taken.*

(3.) *Only two positions of the revolving plane can make the dihedral angles equal to one another ; one having its trace on one side of the profile-trace, and the other on the other.*

Let AB be inclined to the plane MN, and meet it in A ; and let the positions of the revolving planes be BAD, BAE, BAF, BAC, *etc.* : also let AD be perpendicular to AB, and AC the profile-trace of the same line AB ; and let AE make a less angle with AD than AF does. Then,



(1.) The plane BAD makes a less dihedral angle with MN than any other plane BAE does.

For, draw BC in the plane BAC perpendicular to AC, and from C draw the perpendicular CE to the trace AE.

Then, BC is perpendicular to the plane MN (*prop.* 32,) and BE to the line AE (*prop.* 41) : whence BEC is the profile angle of the dihedral angle formed by MN and BAE.

Now since BA is (*hypoth.*) perpendicular to AD, the angle CAD is also a right angle (*prop.* 41, *cor.* 1) ; and if in the plane MN a semicircle be described on CA as diameter, it will pass through E (*Euc. iii.*, 31,) and have AD for its tangent at A (*Euc. iii.*, 17.)

Wherefore, AC will be greater than CE, BC is common to the two triangles BCA, BCE, and the included angles right angles : whence the angle BEC is greater than BAC. But the former of these is the profile of the dihedral angle formed by BAE with MN, and the latter of that formed by BAD with MN. Whence the proposition is true in this case.

(2.) Let BAE, BAF be two positions of the revolving plane, the trace of which the former is nearer to AD than that of the latter : then ABF will form a greater angle with MN than ABE does.

For let the semicircle cut AF in F, and join BF, CF ; the rest of the construction which is necessary being as before.

Then the segment CF of the circle being less than the segment CE, the line CF is less than the line CE. Whence the angle CFB is greater than CEB (*prop.* 43) ; and these are the profiles of the dihedral angles made by the plane, in its two positions, with MN. Wherefore, also, this part of the proposition is true.

The dihedral angles, it is clear, may vary from that whose profile is BAC up to a right dihedral angle.

(3.) Make E′AD′ equal to EAD in the plane MN; then the plane BAE′ will make a dihedral angle with MN equal to that made by BAE; and there can be no other dihedral angle made equal to these by the revolving plane about AB with the plane MN.

For complete the circle on CA, meeting AE′ in E′, and join BE′, CE′.

Then it is proved at once that CE′ is equal to CE, and BE′ to BE. Whence the angles CE′B, CEB are equal, and these are the profiles of the two dihedral angles. These dihedral angles are, therefore, equal. One dihedral angle, therefore, can be made with MN equal to the dihedral angle formed by BAE with the same plane.

Nor can there be more than one such: for the angles made by planes whose traces are nearer to DD than AE is, are less, and those whose traces are more remote, are greater.

ON THE PRINCIPLES OF ALGEBRA, AS A SYSTEM OF GENERAL REASONING; WITH A SKETCH OF ITS RECENT PROGRESS, AND A REFERENCE TO SOME RECENT PAPERS IN THE "MECHANICS' MAGAZINE."

As the propriety of treating such a subject as the present one, in this place, may be questioned, it will be as well to state the reason for doing so. A large proportion, probably, of the readers of this Magazine have *some* acquaintance, however small, with what is usually called "algebra." Still more probable is it, that of these the greater number have never attained to anything like a satisfactory insight into its real nature. Sticking fast in that Slough of Despond which every one necessarily encounters at the commencement of his journey, they have been content (not willingly, but of sheer inability to help themselves) with just sufficient mechanical familiarity to enable them to solve numerical equations and get through the processes of transposition and so on, ordinarily met with in books on mensuration, &c.—the rest being all "legerdemain juggling," &c., to which they have a natural antipathy, and from which they gladly take refuge in some less mysterious study—such as geometry. And yet if such men once got a glimpse of the rational nature of the subject, there would be none more willing to study it carefully, and none to whom its beauty and power would afford greater delight.

Moreover, there are many who have what is called "a turn for metaphysical studies"—that is, in fact, who possess more than the average capacity for general reasoning, who are better fitted than even the majority of *mere* mathematicians, to enter into the intricacies of this subject, and even to extend its mathematical applications. Probably few of those who are interested in metaphysics (I use this word for want of a better) have any notion of the field open to them on acquiring a competent knowledge of mathematics. I do not here refer to those whose tendency is to German mysticism—the "profundity" of which is a mere sham—the profundity of an obscure phraseology in which they only envelop themselves who are unable to think clearly and consecutively. Mathematics—so far from being congenial to them—cannot be pursued for any time and with any success without putting to flight all such misty and dreamy tendencies—or at any rate, not without convincing their owner of what they really are good for. "*Omne ignotum pro mirifico*:" if the Germans of our own day, or their masters, the Platonists of old, had possessed the power of clear and sound thinking and the willingness to take credit for nothing but what they did understand—in short, if they neither humbugged themselves nor others, we should have been spared the nonsense and pedantic assumptions of superiority with which we have been deluged—"*usque ad nauseam*." Well might Dugald Stewart say, "I can, without much vanity, say, that with less expense of thought, I could have rivalled the obscurity of Kant; and that the invention of a new technical language, such as that which he has introduced, would have been an easier task than the communication of clear and precise notions, (if I have been so fortunate as to succeed in this communication) without departing from the established modes of expression."

I fear that a similar charlatanry is becoming, or rather has already become, too common in mathematical writers—especially in the application of mathema-

tics to physics. And I think it ought to be taken as a general rule, that no credit should be given to any writer for understanding his subject, unless he is able to convey his meaning clearly to at least a certain proportion of those who have carefully read and studied his works. The younger students especially require to be reminded that the real mark of *profundity* is the making clear what was formerly obscure—and that simplicity and perspicuity are the mo tnoble attributes of scientific investigation. There are two sources of obscurity, however, in scientific writings which must be distinguished before applying such a rule as that just mentioned. One arises from the omission of several steps in a chain of reasoning—the other from the vague and indefinite nature of the writer's phraseology and terms. The one, is such as occurs in many parts of Newton's "Principia;" the two ideas, or things to be connected, are clearly enough seen, and though, for the sake of conciseness, or some other cause, the intermediate links are wanting, it is a useful and even beneficial task to attempt supplying them. The other source of obscurity, however, is not at all of this kind, but is owing to the writer being utterly deficient of clear ideas himself—or else to a disgraceful affectation of profundity.

I shall now endeavour to give some account of what is meant by "symbolical algebra," and to put together a few hints which may serve to convey to some of your readers, at least, intelligible views of its nature and the legitimacy of the conclusions arrived at by means of it. Those who are at all acquainted with works on what is termed "the philosophy of the mind," will find themselves very greatly assisted by referring to the considerations brought forward in many of them on the subject of "general terms;" and particularly to section 2, of the fourth chapter of the first part of Dugald Stewart's work. It was not till a day or two ago that, on referring to this chapter, I was aware of the clear notions entertained so long ago on the real nature of algebraical processes—by one not himself a professed mathematician. In thus alluding to this part of his work, from which I shall have occasion to make some extracts, it may be as well to remark that I do not coincide with his views as to the *absolute necessity* of words or signs in general reasoning—a view which has been clearly examined and confuted by Dr. Thomas Brown in his lectures.

To every one, however, whether accustomed to works on such subjects or not, I would recommend the reading of this section. Nothing but ordinary acuteness is required to comprehend it, and I think it perhaps likely that many persons will more easily get at the fundamental conception on which the understanding of symbolical algebra rests by this means, than by having their attention fixed solely on algebraical formulæ and symbols.

It is extremely difficult to know how best to *introduce* the explanation of a subject like the present—inasmuch as it is not a proposition we have to prove, so much as *an idea* or *fundamental conception* we wish to convey. The most valuable of all possible inventions would be a mental Daguerreotype, by which thoughts could be transferred from one mind to another, with all their varying shades of intensity, and minuteness, and accuracy of outline. For want of a better, I shall begin with the following illustration:

Conceive the symbol x to mean *the operation of putting on your stocking;* and y to mean *the operation of putting on your boot.* Also let the order in which these two symbols are written denote *the order in which these two operations are to be performed;* so that

yx denotes the operation of first putting on the stocking and *then* the boot.

xy denotes that the boot is to be put on first, and the stocking afterwards.

Now, conceiving further that the symbol $=$ denotes "identity of result," it is not true that $yx=xy$, forasmuch as the first side of the equation denotes that the stocking is inside and the boot outside, whereas the second denotes a violation of this usual order of things, the stocking being outside the boot. But, (still supposing x to denote the same operation as before) change the signification of the symbol y, and suppose now that it means *the operation of putting on one's hat;* and *then* the above equation is true, viz., $yx=xy$, inasmuch as whether a man first puts on his hat and then his stocking, or first the stocking and then the hat, the result is the same.

It is to be understood that the stocking, boot, and hat, are here supposed to be applied to the usual parts.

The student will at once conceive an infinite variety of different *operations* which either will or will not, when denoted by x and y, *satisfy the above equation.* Take for instance some chemical experiment, in which the *order of mixing* the ingredients, does or does not affect the result.

xy is a certain "combination" of two symbols: yx is *another* combination: and the equation $yx=xy$ expresses a certain *law of combination.* Now it is plain, that we may either *begin* by *defining what the symbols* x and y are intended to represent, and then *deduce* this (and other) laws of combination: or, we may go to work the inverse way, and *find out what meaning* it is possible to give to x and y, so that this equation, or law of combination may express a known truth. In other words, in this latter method, we search for all kinds of operations, *the order in performing which makes no difference in the result;* for of all such, it is true that $yx=xy$, the two letters denoting the two operations. This latter method is one of *interpretation.*

We have thus introduced the notions of *general symbols,* (namely y and x), of "*laws of combination*" of such symbols—and of *two sorts of algebra,* in one of which the symbols have a meaning to begin with, and *from that meaning* their laws of combination are deduced; and the other the symbols (x and y) have *no meaning at all to begin with,* but, instead, a law (or laws) of combination are *assumed* (*perfectly at random* if we please), and *then* commences the task of *interpretation.*

It is of primary importance that the student should have clear notions of what are meant by "Laws of Combination." And yet he has the notion itself clearly enough, and has been using the "rules" or laws of combination throughout the whole of his algebraical course. Open any book containing algebraical examples or processes: then he knows that wherever he sees the three symbols, $a+b$, he is at liberty to write $b+a$ without in any way altering the result. This is therefore *one* rule or law of combination, viz., that $a+b=b+a$. Again, wherever he sees ab he can write ba instead, or wherever he sees $m(a+b)$ he can write $ma+mb$; or, wherever he sees a^{-1} he can write, $\frac{1}{a}$. All these are *laws of combination.* And common algebra, as practised by every schoolboy, is simply working according to these rules, in other words, combining symbols according to these and other similar laws. After he has got a little way into this habit, he never thinks at all *what* the symbols (a, b, and so on) *mean.* He knows, as a matter of experience, that this question—namely, as to their meaning, has nothing whatever to do with his work: the result he is aiming at not being at all affected by it. (Suppose, for example, that he is trying to show that $a^2-b^2=(a+b)\ (a-b)$, or that $(a+b)^2=a^2+2ab+b^2$). It is true, that *whenever* he does think at all about the meaning of these symbols, a, b, x, y, &c., he considers them to be some *numbers* or other; or at last, he gets to look upon them as simply standing for *any* numbers indefinitely. Having got a clear idea of what is meant by "laws of combination of symbols," it is seen that these "laws" may be either *necessary* or *arbitrary,* according as the symbols are supposed to be *with* or *without* given significations. These "laws," or "rules" are *necessary* when the symbols are expressly used to denote some known operation, or magnitude—in short, when they themselves are *not arbitrary.* Thus, in the illustration at the beginning of this article, $xy=yx$ is a *necessary* law of combination, when certain operations are designated by x and y, and *not* a law of combination at all, when certain other operations are supposed to be designated. It is *necessarily true* for *some meanings* of x and y, *necessarily false* for others. That is, "necessarily" *from the very nature of the operations themselves.* In some cases or classes of operations which we might fix upon, the above equation, or law, has no meaning itself—or it may be impossible. For instance, if we suppose the symbol x to denote the operation of tying a knot in a string and the symbol y to denote the operation of untying the knot—then yx represents a possible series of operations, namely, that of first tying and then untying: whereas the arrangement xy represents the *impossible* series of first untying a knot (which does not exist) and then tying it.

If we thus *begin by defining the symbols,* the laws of combination *follow* and are *necessary* laws.

But if we begin by leaving the symbols *undefined* and perfectly arbitrary, we are at liberty *to impose the laws of combination* ourselves: thus, *in some sort defining* the symbols, inasmuch as we thereby subject them to certain conditions. In this case, having started with *arbitrary* laws of combination, we must seek amongst all possible significations of the symbols, those which, *from their nature are subject to these laws.* Of course, the number and nature of the laws we thus impose being absolutely without limit, as well as the operations, which satisfy the conditions, we are guided in the choice of both—viz.: of the laws to be imposed as laws of combination, and of the interpretations which are admissible—by a reference to their utility. For it would be absurd to create an algebra, for the symbols of which we could find no significations which will render the results useful in some department of science or other. In point of fact, we have but three or four such algebras—and the laws of combination in each have been originally suggested by (and are most of them indeed the same as) the laws of combination of arithmetical symbols—*i. e.*, numbers. We are thus led to the *history* of the subject; but before entering upon it and showing how the systems of symbolical logic of the present day have grown out of the child's arithmetic, it will be advisable to inquire into the notions usually entertained by students on the nature of algebraic processes and theorems.

There are very few who would not be sadly at a loss if asked to define "algebra"—and explain what it is, *what* they have learnt by it, and *how* they have learnt. A tolerably decent account might perhaps be given of simple equations, arithmetical and geometrical progression, and a few more portions. Let us take the binomial theorem however, and we ask the following questions:—

(1). What are the axioms and postulates on which it is founded?

(2). What are the steps in the process of deduction or "proof" which you represent to yourself, on running over it in your mind?

(3). Which of these steps do you consider *essential*, and which not?

These questions are not perhaps the best adapted to elicit the real views of the student; but they may serve partially to do so. Those who have thought most attentively about it, will probably not be able to give any much more lucid account of the matter than this. That a and b (or whatever be the letters used) are considered to be *numbers*, but not any *particular* numbers; and that the final result is obtained by several repetitions of the "ordinary process of multiplication in algebra"—the number of times the process is repeated (in other words the numerical value of the index), being perceived to make no difference in the form of the result. So far the theorem being considered merely for the case of a positive and integral value of the index. That as to the case of a negative or fractional index, "by going through the usual algebraic processes of division," we get to that too, somehow (some would not hesitate to say, "by the usual *juggling*"). Some might have "read" Euler's proof, and have conceived, in consequence, the possibility of receiving some new ideas on the matter, "which were not dreamt of in their philosophy," or in the old school of "Algebras." He has, nevertheless, sundry notions, which have not been mentioned, which contain the germ of more correct and connected views. For example, he is aware, that in the case of a fractional index, the *interpretation* of the symbols is now no longer the same as it was when the index was a positive whole number. He does not look upon the symbol $a^{\frac{1}{2}}x^{\frac{1}{2}}$ for instance, as admitting of a *similar* interpretation to that which a^2x^3 admits. They are so far similar, that $x^{\frac{1}{2}}$ *when expressed as a number*, is to be multiplied (in the usual arithmetical sense) by the other factor $a^{\frac{1}{2}}$, when that has also been expressed as a number; just in the same way that x^3 (when expressed numerically) is to be multipled by a^2. *But the operations necessary in order so to express* $x^{\frac{1}{2}}$ and and $a^{\frac{1}{2}}$ numerically, are *different* in their arithmetical nature from those operations which are gone through to express x^3 and a^2 numerically. In short, *the system of interpretation* is altered, *even though every symbol be still considered as a number.*

Returning, however, to the conside-

ration of the successive steps by which the theorem is obtained, and of the fundamental conceptions on which it is built, we ask, *Where* does the idea of *number* come in? And what reason is there for a and b (or whatever letters are used) to be numbers? How do you make out that their numerical nature is an *essential condition* to the truth of the theorem? On attentive reflection, it cannot but be seen that this idea of numerical value does not enter at all into the *process* itself. As before remarked, the whole series of operations is carried on entirely independent of even the slightest reference to *any specification whatever* of the symbols a and b. All that is attended to, is simply certain *laws of combination of these symbols*, such as $a^m \times a^n = a^{m+n}$, and so on. It is true that this and the other laws of combination used, were originally suggested by purely arithmetical notions, and that up to the present stage of the student's progress, IF THEY *are to have any meaning at all*, this arithmetical notion is the only one which will occur to him.

The idea of the index being a number (and a positive whole number, too,) enters when the general form of the theorem is seen to be unaffected by the *number* of times the process of multiplication is repeated.

But with regard to a and b, it will be without much trouble perceived that the idea of their representing numbers really does not enter into the process itself by which the theorem is obtained, but solely into the *interpretation* of the two sides of the equation finally obtained—in other words, the interpretation of the theorem itself.

A. H.

(*To be continued.*)

INQUIRY RESPECTING MURPHY AND BUTTERWORTH.

Sir,—Can any of your correspondents supply information respecting the latter days of Robert Murphy and John Butterworth, of Oldham? Murphy was one of the most distinguished analysts of the present century, and Butterworth was a geometrician of very superior talents. I fear that some painful particulars could be related in reference to the closing career of both these benefactors to science. Murphy's death was, I believe, attended with melancholy circumstances; and poor Butterworth's, I suspect, with events still more melancholy and distressing. It is not right that men who have toiled their day in the service of science, and have left the indelible impress of their genius behind them, should thus be suffered to drop into their miserable graves, and pass away without some brief record of their struggles: that is, of their *reward*.

I learn that some time before his death, Butterworth was an inmate of the Mendicity Society's establishment in Dublin; but whether or not he *died* there I am unable to ascertain. How he *lived* there may be gathered from the following quotation from a recent writer:

"To eke out the daily diet of the poor creatures, carts were sent round to the houses of the upper and middle classes to collect such fragments of broken victuals as in other countries find their way to the dogs or the dust-hole; and one can hardly reflect with unmoved stomach upon the heterogeneousness of substances—the sweepings of the kitchens of an Irish city—so gathered together. Fish, flesh, and fowl—raw and cooked, fresh and tainted—bones, puddings, potatoes, crusts, pastry, flaps, scraps, confectionary, and kitchen-stuff, all jumbled together in a cart, and dragged about through a sweltering summer-day, till the festering mass was shot down at evening before the squalid and famishing crowd in the yard of the institution."

What was it that seduced John Butterworth from his native country? Was he inveigled by a set of joint-stock speculators in British talent, and then defrauded of his pay, and left to starve? Such things have been, and *are*. We hear much of late, as well as we did formerly, of the *neglect* of men of science; but I fear there is often more than neglect to complain of. The victim himself is generally the last man from whom we can learn his case; he too frequently submits, in silence and in sorrow, to wrongs which "the hewer of wood and drawer of water," who has no *name* to be exposed in the conflict, would successfully contend against; and those, out of his own family, who observe his sinking health and grave-bound course, attribute all to his *studies*; and urge upon him relaxation, change of air, and a generous diet!

A distinguished person has written an interesting work on "The Pleasures and Advantages of Science." A supplementary chapter is much wanted: "On the *Rewards* of Science;" but this must be written by another hand. John Kepler has supplied a leaf.

I am, Sir, yours, &c.,
A CONTRIBUTOR.

Sept. 6, 1848.

P. S.—I find the following notice of Mr. Butterworth at p. 72 of the *Lady's and Gentleman's Diary*, for 1847:

"Mr. Butterworth died on the 3rd of December, 1845, aged 71 years. He was an able mathematical contributor to the Diaries and other mathematical periodicals for many years. His talents were most conspicuous and remarkable in the solution of geometrical problems, which he usually treated in an elegant manner. His friends and more immediate admirers have caused a neat marble tablet to be erected to his memory in St. Paul's Church, Royton, in the yard attached to which his remains were deposited."

I believe it was Sir Robert Peel who, some years ago, suggested that "marble tablets" should be erected to men of intellectual eminence in another "St. Paul's," or in Westminster Abbey. A happy idea! they ask for subsistence, and they are offered a tomb — for "bread," and they receive "a stone!"

FIRING SHELLS BY ELECTRICITY.

New York, August 11, 1848.

Sir,—Your valuable Journal for Nov. 21, 1846, contained a paper for exploding shells by electricity. This has been republished in this country with some additional remarks, which are, in many respects, as important as the original communication; and, on perusal, I feel confident you will find them worthy of an insertion. A great number of experiments have removed all doubts of the practicability of this method, and to make it generally introduced, it only requires to be brought to the knowledge of practical men, who cannot fail at once to see its great advantages.

Yours truly,
SUBSCRIBER.

[We feel much obliged to our correspondent for the additional information with which he has supplied us on this interesting subject, and which we here subjoin. The inventor is Lieut. Henry Moor of the United States Navy.—ED. M. M.]

The loaded shell is prepared with the end of a coil of wire attached to it, which, on being discharged from the mortar, it carries out with it like the string of a kite. The length of the coil is considerably greater than the distance to which the shell is to be thrown, and being laid so as to run freely, the inner end of the wire is not disturbed by the motion of the shell, but is free to be taken to a galvanic battery at any moment during its flight. It is a species of the magnetic telegraph applied to the flying shell, which it overtakes and explodes with the rapidity of thought. This method can only be used to advantage when the shell is projected with a moderate velocity, so as to be distinctly visible during its flight. This can be done to a distance of about 2000 feet; as a large shell projected with no greater velocity than sufficient to carry it to that distance, can be distinctly traced by the eye from the moment of its leaving the mortar to the end of its flight. The person in charge of the explosion keeps his eye fixed on the shell, and as it passes nearest to the desired point of attack effects the explosion by a single motion of the hand, without once diverting his eye from the shell. As shells are at present used, they cannot be made to explode at the moment of coming into contact with an object, and in the open field are of no more service against a body of men than a shot of the same diameter; as the explosion cannot be depended on at the desired moment. But by effecting the explosion at the precise instant of coming in contact with a body of troops, the effect is increased a hundred fold. A constant succession of such explosions would destroy any body of men. The effects of the shell would not be confined to the immediate vicinity, but would extend to a great distance in all directions, according to the magnitude of the shell and the powder it contained.

The light 10-inch mortar weighs 1800 lbs., and carries a shell of 100 lbs. weight, containing 4 lbs. of powder. This great weight of the shell is intended to give it sufficient density and strength to project it to a great distance, and to penetrate hard substances. But for use in the open field a 10-inch cylindrical shell of the same length, made of half-inch wrought-iron, weighs 55 lbs., and carries 20 lbs. of powder, and has sufficient density and strength to project from one to 2000 feet. By increasing the length of the shell, the quantity of powder could be proportionally increased. A fortification armed

with shells of this description would have an inexhaustible supply of mining above ground, or, in other words, of throwing magazines into the midst of an enemy and exploding them there at the most decisive point. And as this could be done from a distance of 2000 feet up to the very walls, no force could approach near enough to carry the works by the usual method. There are many other applications of this method, particularly to destroying ships, from the great extent of inflammable surface which they expose in the sails, spars, and decks; but these will be reserved for a future communication.

The distinguished feature of this method is the power that is retained over the shell of exploding it, as it is observed to pass nearest to the point of attack, and at that instant expanding it into a thousand times its original volume, so as to envelope and destroy everything that is perishable within 20 or 30 feet of its range. This enormous volume will be as effectual against any force, without entrenchments, as a solid shot of the same diameter which would weigh several hundred tons. For distant firing, no change is to be made in the present method; the same shot and shells to be used as heretofore, until the firing approaches to within about 500 yards, when the cylindrical shells are to be used with the new method of explosion.

A 6-inch cylindrical shell, one foot in length and a quarter of an inch thick, to fit a 32-pounder, weighs 20 lbs. and carries 12 lbs. of powder. This loaded shell weighs 32 lbs., and has one-third the weight or density of solid iron, and requires but a moderate velocity to project it to a distance of half a mile. For shorter distances the length of the shell may be increased to two or three feet, so as to contain from 20 lbs. to 30 lbs. of powder, and it can be thrown with sufficient accuracy to produce the most destructive effects. In the same manner the 8-inch shell, with a length of from two to three feet, will contain from 40 lbs. to 50 lbs. of powder, and the 10-inch from 60 lbs. to 80 lbs. These shells are to be projected from the guns at present in use, after the necessity for distant firing has ceased; and they will afford a means of attack and defence at close quarters which it will be impossible for any force to withstand. In general, no change in the armaments will be required for the use of these shells; they can be fired from any kind of guns at close quarters.

There is a very light species of brass ordnance (cohorn mortars) which might be used with advantage with these shells. A 10-inch mortar of this description weighs but 700 lbs., and has sufficient strength to project a cylindrical shell containing 30 lbs. of powder. As the weight is only about the same as a light field-piece, it could be easily transported, and at close quarters it would be more effectual than a whole park of small artillery.

DESCRIPTION OF AN ELECTRO-MOTIVE ENGINE CONSTRUCTED ON THE SUPPOSED PRINCIPLE OF MUSCULAR ACTION. BY W. FRASER, ESQ., M.R.C.S.E.

[Being the substance of a Paper read before the Medico-Chirurgical Society of Aberdeen, 6th of July, 1848.]

Having several years ago had an opportunity of seeing a number of electro-motive machines of various constructions, I was much struck by observing the extreme weakness of the power rendered available for practical purposes by the different mechanical arrangements employed, compared with the tremendous force actually exerted, under certain circumstances, by the moving power made use of. An electro-magnet, which would, within its proper sphere of power, attract to itself, and retain suspended a weight of many tons, could not be made by any of the arrangements I saw employed, to perform the twentieth part of the labour of one horse.

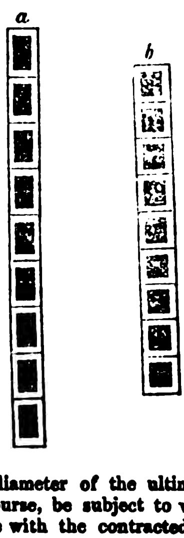
I shall not occupy your time by describing what those arrangements were, as most of you have seen them as well as myself, but come at once to the description of one upon an entirely new principle, which I have carried into effect with the happiest result, and of which the idea was suggested by the mode in which the muscular force appears to be exerted in that microcosm or little world—our own body, the proper study of which I believe to be capable of affording the key to many hitherto unsolved problems in various departments of science.

It has for some time been a current belief in physiology, that the contraction of muscles is produced by the mutual attraction of minute cells or globules, arranged in parallel lines, of which the ultimate fibrils of the muscular tissue consist. The stimulus that excites this attraction, is the vital electricity, or the nervous or bio-galvanic current, transmitted by the nerves, and brought to bear upon the muscular globules by means of the ultimate nervous filaments, which interlace among them, and form a network of anastomoses, so as to complete the circle or current of nervous influence, of which the fountain, or, at all events, the prime-motor, is the brain or spinal marrow. The aggregate of these minute movements gives the extent of contraction of the entire muscle; the combined force of these molecular attractions, its full power or strength.

The following extracts and figures, from Dr. Carpenter's "Manual of Physiology," will place the subject more clearly before us:—

At p. 200, he says, "When the fibrillæ are separately examined under a high magnifying power, they are seen to present a cylindrical or slightly beaded form, and to be made up of a linear aggregation of distinct cells. We observe the same alternation of light and dark spaces as when the fibrillæ are united into fibres or into small bundles; but it may be distinctly seen, that each light space is divided by a transverse line, and that there is a pellucid border at the *sides* of the dark spaces, as well as between their contiguous extremities.

"This pellucid border seems to be the cell-wall: the dark space enclosed by it (which is usually bright in the centre), being the cavity of the cell, which is usually filled with a highly refracting substance. When the fibril is in a state of relaxation, as seen at *a*, the diameter of the cells is greatest in the longitudinal direction; but when it is contracted, the fibril increases in diameter as it diminishes in length, so that the transverse diameter of each cell becomes equal to the longitudinal diameter, as seen at *b*, or even exceeds it.



"The diameter of the ultimate fibrillæ will, of course, be subject to variations in accordance with the contracted or relaxed condition; but it seems to be otherwise tolerably uniform in different animals, being, for the most part, about 1-10,000th of an inch. The average distance of the striæ, too, is nearly uniform—about 1-10,000th of an inch in different animals, though considerable variations present themselves in every individual, and in different parts of the same muscle."

On the subject of the arrangement of the nerves and tendons in connection with muscles, the same authority says, p. 203, "The muscles of animal life are, of all animal tissues except the skin, the most copiously supplied with nerves. These, like the blood-vessels, lie on the outside of the myolemma of each fibre, and their influence must, consequently, be exerted through it. The arrangement of these nerves is shown in the annexed figure. Their ultimate fibres or

tubes cannot be said to terminate anywhere in the muscular substance; for, after issuing from the trunks, they form a series of loops, which either return to the same trunk or join an adjacent one. The occasional appearance of the termination of a nervous fibril, is caused by its dipping down between the muscular fibres, to pass between another stratum.

"Every muscular fibre, of the striated kind at least, is attached at its extremities to fibrous tissue, through the medium of which it exerts its contractile power on the bone or other substance which it is destined to move. Thus the whole muscle is penetrated by minute fasciculi of tendinous fibres, and these collect at its extremities into a tendon."

Of the anatomical arrangement now described, the electro-motive machine I have constructed is as close an imitation as possible: it consists of a number of electro-magnets opposed endwise to one another, arranged in parallel lines, and connected together by fastenings in such a way that, when made to act simultaneously, their united force can be brought to bear upon one point.

The annexed figures will give an idea of the apparatus, both in a state of repose and of action, or, to speak analogically, in the opposite states of relaxation and contraction.

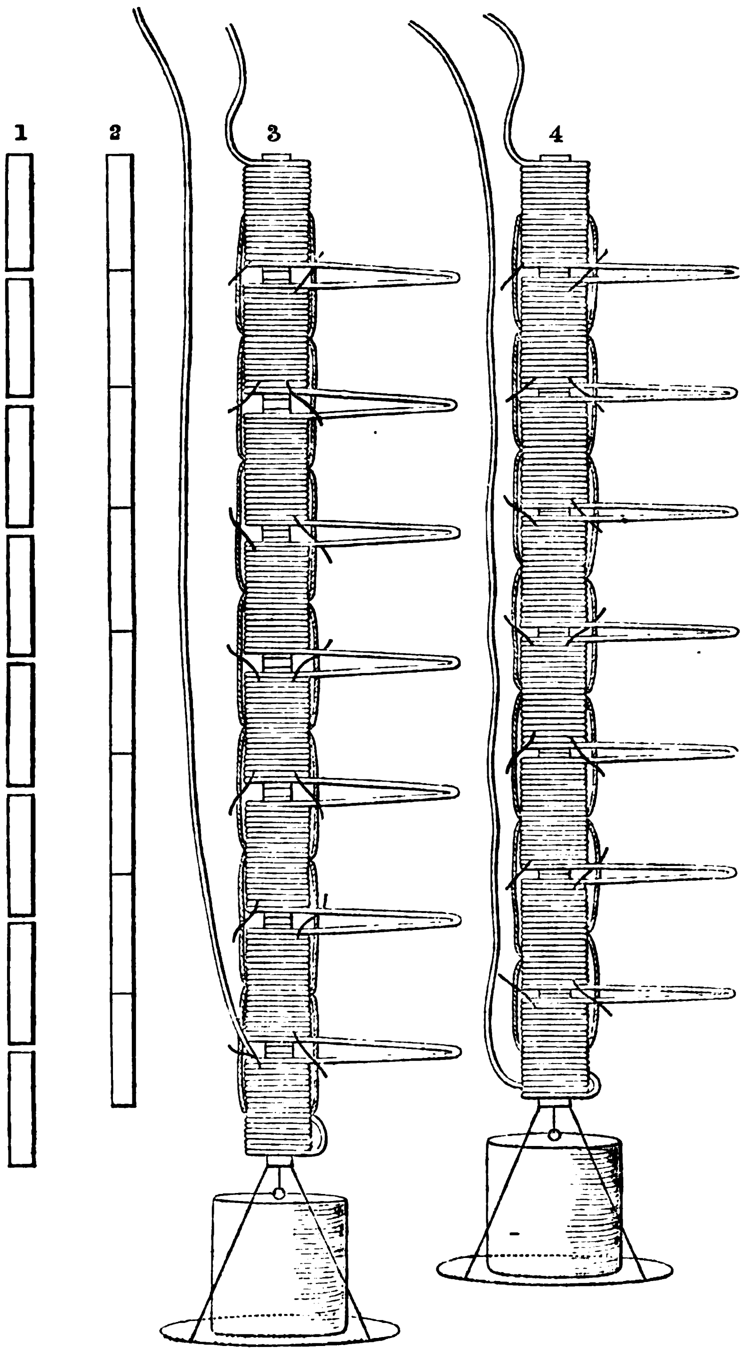

1
2
3
4

Fig. 1 represents a series of eight rectangular prisms of soft iron, one and one-eighth of an inch long, by a quarter of an inch square, placed endwise, at the distance of one-twelfth of an inch from one another. Fig. 2 shows the same, in close contact. Figs. 3 and 4 represent the prisms in the same relative position, but armed with a continuous covered copper wire, and connected together in such a manner as to admit of free motion within a limited extent. Each prism has covered wire, about one-twentieth of an inch thick, wrapped round it closely and regularly, in three layers, and, before being carried to the next prism or magnet, the wire is extended out for about an inch and a half at right angles to the prism, and bent back again at an acute angle, by which means the resistance it offers to the motion of the magnets is almost entirely overcome.

The prisms or magnets, with their opposite poles opposed to each other, are connected together by ligaments of catgut, the length of which can be so graduated, by twisting them by means of a small pin (which can be fixed by having its end inserted among the wire), that any distance that may be necessary can be assigned as the limit of motion to the magnets. It is proper to mention that the prisms are all bound together by two bands of vulcanized India rubber, in close contact with their opposite sides, and sufficiently on the stretch to overcome entirely the weight with which, when hanging perpendicularly, one part of the apparatus would bear upon the other.

The advantage of the arrangement now described is, that as the same current of galvanism is equally efficient in rendering many prisms magnetic as one, and the motions produced by the magnetic influence are, by the way in which the prisms are in the apparatus connected together, communicated from the one to the other, and all accumulated or brought to bear at the end of the series, the amount of power gained is just the attractive power of one prism multiplied by the number in the series, deducting, of course, the resistance to be overcome by moving the additional number of magnets.*

Supposing one electro-magnet to be capable of raising three pounds one-twelfth of an inch, by combining 96 of them into one chain or series, in the way shown in the model, there would be attained a power of raising three pounds a distance of $\frac{96}{12}$ of an inch, or 8 inches; but allowing the additional magnets and their appendages to weigh one pound, and to be provided with no counter-balancing arrangement, then it is evident that the actual power attained would be only that of raising two pounds a height of 8 inches. But, by combining 100 such columns, each containing 96 magnets, there would be attained a power of raising 200 pounds 8 inches, or 100 pounds 16 inches, or 50 pounds 32 inches, &c., according to the manner in which the combination was made.

Figures 5 and 6 show how the chains of magnets might be combined into a compound machine: one end of them being

Fig. 5.

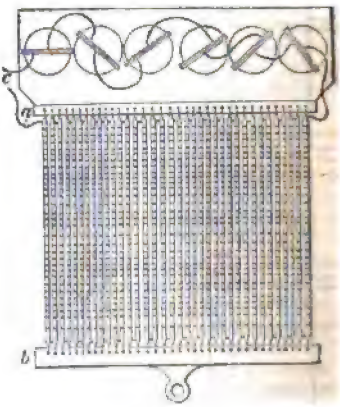
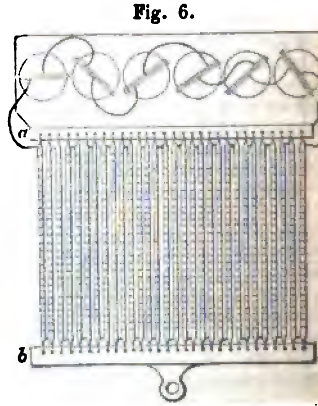


Fig. 6.



attached to the fixed beam *a*, near which the battery (in this instance a Smee's of six jars) is placed, their other extremities being fixed to the moveable beam *b*, from which any motion required could be easily taken. In fig. 5 the magnets are in a relaxed state, their connection with the battery being

* The apparatus above described, which weighs five and a half ounces, with the aid of a moderate battery lifts a pound and a half a distance of nearly half an inch. Its action is almost instantaneous; and the shock with which it becomes rigid or relaxed, as the stimulus is applied or withdrawn, reminds one very forcibly of the spasmodic action of a muscle.

broken; while in fig. 6 they are in a state of contraction, the circuit of wire which connects them with the battery being complete.

By combining a number of such frames together, all connected by the same wire, and by augmenting the strength of the battery, any degree of power might be obtained, and, as in the steam engine, the apparatus might be easily made self-governing in its action, by having a small cup of mercury with which one of the wires was connected, placed, say at c, fig. 5: the other end of the wire could be made alternately to dip into it and emerge from it, by means of a pendulum, so as to break and restore the connection, and thus keep the machine going with any degree of frequency that might be required.

Various expedients might be employed to neutralise or counterbalance the weight of the apparatus, if the power to be thus gained were thought a sufficient object. Thus, the magnets, supposing them to hang perpendicularly, might be articulated together by elastic ligaments strong enough to overcome their weight, and no more; or they might, if placed horizontally, be provided with small wheels, and made to move in a sort of railway.

Upon the whole, it is evident that the power of such an apparatus would depend upon the perfection of its mechanism, and upon the fidelity with which it could be made to imitate the model which Almighty Wisdom has presented to us in the muscular structure and action. And, as the force of the attraction of electro-magnets increases prodigiously as their distance diminishes, (inversely as the square of the distance?) it follows that the smaller and more numerous the component magnets of the machine could be made, the greater would be the power attained. But in this respect, it is not to be expected that human ingenuity could ever be able to reach, by many hundred, I might say thousand, degrees, the minuteness of the muscular tissue. Yet even if the motive power attained were only a five-hundredth part of that which muscle *can be made to exert*, in proportion to the weight of the apparatus, this would be a very great advance upon the results that have hitherto been arrived at in this department.

Though, undoubtedly, it will be long before electricity be brought to supersede, or even to compete with steam as a source of mechanical power, yet such a result need not be looked upon as chimerical, after the extraordinary properties it has been discovered to be possessed of, and the wonders we have seen effected by it, within the last few years.

Another necessary step towards this consummation, besides the perfecting of the mechanical arrangement, would be the discovery of a cheap source of galvanism; one whose price would not exceed that of the fuel employed in the production of steam. But that the very same source from which steam is obtained may be made available for the generation of electricity, is proved by recent experiments; though whether in a form suitable as a source of electro-motive power, yet remains to be ascertained.

MATHEMATICAL PERIODICALS.

(Continued from page 204.)

IX. *The Leeds Correspondent.*—(*Continued.*)

Questions.—The total number of questions proposed and answered in this periodical is 300, exclusive of those under the head of "Questions for Youth." The first 25 contained most of those left unanswered in the *Enquirer*, of which this work may be considered as a continuation, and the whole series may be conveniently classified under the following heads:—

1. *Algebra in General.*—Question 6, 9, 50, 52, 67, 70, 97, 109, 116, 118, 123—4, 130, 145, 150, 163—5, 185, 189, 220—1, 232, 247, 263, 294.

2. *Diophantine Analysis.*—Ques. 1, 14, 30, 34, 39, 53, 59, 61, 62, 83, 102, 106, 122, 143, 153, 166, 204, 207—8, 211, 218, 238—9, 297.

3. *Series.*—Ques. 60, 180, 183, 234, 236, 249.

4. *Chances.*—Ques. 41, 128, 161, 173—4, 195, 210, 246, 251, 265.

5. *Geometry, Geometrical Analysis and Construction.*—Ques. 8, 13, 16, 19, 20, 23—5, 29, 31, 33, 35—6, 40, 42, 43, 45—6, 51, 57—8, 64—5, 72, 74, 77—8, 80—2, 85, 88, 90—1, 93, 95, 98—9, 100, 103, 105, 110, 114—5, 117, 119, 126, 133—5, 138, 148, 154—9, 168, 171—2, 177—9, 181, 191, 193, 194, 197, 202, 206, 209, 212—3, 216—7, 219, 222, 225—6, 229, 237, 241, 249, 250, 252—8, 261, 272—7, 280—3, 286, 291, 293, 295, 299, 300.

6. *Application of Algebra to Geometry, Mensuration, &c.*—Ques. 2, 4, 5, 10, 15, 17, 26, 29, 31, 66, 68, 73, 75, 101, 107, 115, 127, 131, 134, 144, 146, 148, 160, 167, 186, 188, 199, 215, 222, 224—6, 242, 253—4, 261—2, 277.

7. *Trigonometry, Plane and Spherical.*—Ques. 3, 27, 49, 55, 112, 132, 151, 200, 201, 215, 233, 244, 279, 284, 288, 291, 292.

8. *Astronomy.*—Ques. 230, 240, 243, 260, 270, 289, 290,

9. *Fluxions.*—Ques. 12, 18, 32, 46—7, 56, 62, 71, 79, 86—7, 89, 108, 111, 129, 139, 147, 182, 184, 190—1, 203, 237, 264, 278, 296.

10. *Hydrostatics.*—Ques. 28, 56, 92.

11. *Loci, Quadrature, Rectification, &c.*—Ques. 7, 38, 62, 84, 104, 113, 120, 125, 140, 142, 152, 162, 175, 176, 198, 214, 245, 264, 266, 269, 285, 298.

12. *Statics and Dynamics.*—Ques. 11, 21, 22, 27, 44—6, 48, 54, 63, 76, 94, 96, 121, 136—7, 141, 149, 169, 170, 181, 187, 192, 196, 205, 223, 227—8, 235, 248, 259, 267—8, 271.

*** In this, as in most of the other periodicals, it will be observed that geometry preponderates; and though other branches of mathematical science begin to attract more than usual attention, it is evident that the efforts of Woodhouse, Peacock, Herschel, and Babbage to introduce a taste for analytics, however successful they might be at the universities and public schools, were unavailing so far as regarded most of the non-academical correspondents of the mathematical periodicals. The *sameness* of the principal contributors to these works may, perhaps, be one reason why the transition was not more rapid; but another, more cogent and fundamental, is assigned by your able correspondent, "A. H.," in his paper "On the Comparative Advantages of Geometrical and Analytical Studies," contained in pp. 325—8, vol. xlviii. of this Magazine. Be this as it may, the lovers of *pure geometry* will find in the "Correspondent" an intellectual treat of the first order; nor is it to be imagined that more *general* readers will be *much* displeased on finding the work to contain so many of the very able and elegant productions of such geometers as Butterworth, Kay, Winward, Whitley, and Swale.

Ques. 40 is a geometrical analysis of the often-proposed problem "to determine whereabouts between the earth and moon a spectator must be placed so as to see *equal* surfaces of both bodies." The 64th and 80th relate to the intersection of a fourth circle with three given ones:—a case of the latter was proposed as question 1594 of the *Ladies' Diary* for 1835, and was solved by Messrs. Woolhouse and Trotter in the following year. Mr. Woolhouse referred to the same problem in the *Correspondent.* Ques. 87 is the same as ques. 5, page 36 of the *Ladies' Diary* for 1817, respecting which, some remarks made by Mr. Edward Riddle, in the *Diary*, called forth a rather severe reply from Mr. Gawthorp in the next number of the *Correspondent*, which were again replied to by Mr. Riddle in the *Diary* for 1818. Ques. 91 corrects an error in prop. 16, B. iv., of "Simpson's Geometry." Professor Young claims the detection of this error in his "Geometry," pp. 9—199; but that he was anticipated has been shown at pp. 248-9, vol. xlvi. of the *Mechanics' Magazine.* Question 97 corrects an error in Simpson's and Bonnycastle's Algebras, respecting the number of possible values of the equation $5x+7y+11z=224$. Question 106 is the same as No. 1779 in the *Diary* for the present year, proposed by Mr. Hogg. Ques. 117 exhibits a curious geometrical method of dividing a circle into *sixteen* parts, so that their areas and perimeters shall be equal: the methods of Dr. Hutton, and that of drawing radii to the circumference being excepted. Ques. 122 is a curious diophantine one, and gives "general expressions for the area, sides, diagonals, and the diameter of the circle circumscribing a trapezium, the sum of its diagonals being a square number." Questions 135 to 142 are from the "Senate-House Problems" for 1814 and 1815, different solutions to which may be seen in Wright's solutions to the "Cambridge Problems." Three of our ablest living mathematicians commenced their career in this periodical. Mr. Wm. Godward was a constant contributor, first to the junior, and afterwards to the senior department. The Rev. Thomas Gaskin, M.A., appears as Master T. Gaskin in No. 4, vol. ii., and No. 1, vol. iii.; and Professor Davies, of Woolwich, is found at Sheffield, the answerer of ques. 144 and the proposer of ques. 165.

Ques. 159, by Mr. Whitley, generalizes for any polygon the property of the triangle given by Professor Playfair, in Art. 28 of his "Origin and Investigation of Porisms," a demonstration for which case was given by Mr. Skene, in pp. 13, 14 of the Appendix to the *Mathematical Companion* for 1805. Ques. 198 is the prize question left unanswered in the *British Oracle.* Ques. 211 shows how to divide every *square* number into

three *cubes*. Ques. 220 contains a proof that $(\sqrt{-1})^{\sqrt{-1}}$ is a real quantity; and Ques. 224 proves that the greatest ellipse which can be inscribed in a triangle *bisects* the sides at the points of contact, which property has also been proved by Mr. Cunliffe, at page 353, vol. iv. of "Leybourn's Edition of the Diaries," where also may be seen an analytical investigation by M. Berard, from vol. iv. of the "*Annales de Mathematiques*." Ques. 240 is a prize question, by Mr. Whitley, and contains a computation of the beginning, middle, and end of the transit of Mercury in May, 1832, from "Delambre's Tables." Ques. 260 is also a prize by Mr. Whitley, and determines the "nearest distance and direction" a person "must travel to see the beginning of the transit (of Mercury in 1822) at sunrise." Ques. 270 is another prize, which determines "the length of the tropical year:—1. From the transits of Mercury over the Sun's disc. 2. From the oppositions of Mars. 3. From the oppositions of Saturn." These results agree with what M. Biot has determined by other methods. Ques. 272 is the 12th lineal section in the *Student;* elegant analysis and constructions are given by Messrs. Winward, Rutherford, and Marsh. "Pen-and-Ink" (*qu.* Davies?) has also given an elegant analysis of the same problem, at p. 534, vol. xlv. of this Magazine. Ques. 275, solved by Messrs. Whitley and Rutherford, gives the analysis of the problem, "To constitute a trapezium of a given magnitude under four given lines," which is the last problem in the "Appendix to Simpson's Algebra." Ques. 278 was proposed by Mr. William Marrat, and requires "to find, *à priori*, the integral of sin xdx:" it contains the earliest instance of the use of the differential notation I have met with in any of our periodical works. Ques. 280 was proposed and answered by Mr. Whitley, and proves, that "if a polygon be inscribed in a conic section, so that each of its sides, except one, may be parallel to a straight line given in position, then that side will either touch a conic section similar to the given one, or it will be parallel to a straight line given in position." This is shown, *geometrically*, to be the case in the circle for all figures, from a triangle up to a heptagon, and by the principles of *projection* the property is extended to the conic sections in general. At the close of the solution occasion is taken to correct a mistake on this subject in the prize question in the *Mathematical Companion* for 1813. This theorem, independent of its geometrical beauty, is fertile in consequences: and other demonstrations have since been given of it, without any projective considerations by Messrs. Woolhouse and Davies. Leybourn's Repository, vol. vi., p. 42—8. The latter gentleman has repeated his demonstration in his edition of Hutton's Course, (the 12th) p. 183-4; and as one instance of its value, we may quote the last volume of this Magazine, p. 396-8, where Mr. Gaskin has rendered it subsidiary to the solution of one of the most difficult problems that has ever engaged the attention of geometers. Ques. 289 determines "When the sun rises out of the horizon in the least time possible," a problem equivalent to that of the "shortest twilight," solutions to which are given by Messrs. Rutherford, Winward, and Whitley. From Ques. 300 is deduced the following neat porism, which is that referred to in the solution to the prize question in the *Diary* for 1841:—"If from two points assumed at pleasure in the opposite sides of a quadrilateral, four straight lines be drawn to the angles, their points of concourse and the intersection of the diagonals will always be in a straight line." This is, however, a case of that Protean property, *the mystic hexagram* of Pascal; when the conic section degenerates into two straight lines. Perhaps few propositions have been so often *rediscovered* as this, from the time of Pappus down to that of Swall, who proposed it in the *Leeds Correspondent*. See *Pappus*, vii., 139, and *Chasles' Aperçu Historique des Méthodes en Géométrie*, p. 89.

Contributors.—Messrs. Baines, Bartholomew, Bronwin, Butterworth, Clay, Cook, Crowther, Darby, Eyres, Garrow, Garside, Gawthorp, Godward, Harvey, Holt, Hattersley, Hine, Hirst, Huntington, Jones, Johnson, Jerwood, Kay, Lewthwaite, Lightbown, Longbotham, Macauley, Maffett, Marrat, Marsh, Nesbit, Ogden, Parker ("Iota,") Putsey, Ryley, Rutherford, Settle, Shillito, Shepherd, Smith, Sollitt, Stringer, Swale, Thomas, Todd, Treeby, Wilkinson, Webster, Whitley, Winward, Wiseman,

Wright, &c., &c. Mr. Whitley wrote under various signatures, such as "Amicus," "Plus-Minus," "Philo-Veritas," "N. Y.," "Geometricus," "Nov.-Anglus," &c., &c.

Publication.—The first three volumes were issued in half-yearly numbers, and the last two volumes in quarterly ones, allowing for some interruptions in the publication of certain portions. It was printed by and for James Nichols, first of Briggate, Leeds, then of 22, Warwick-square, London, and was sold by Baldwin, Cradock, and Joy. Mr. Nichols himself is favourably known in the literary world as the translator of the works of Arminius, as well as by some other writings.

THOMAS WILKINSON.

Burnley, Lancashire, Sept. 2, 1848.

ERRATA, VOL. XLIX.

p. 5, *col.* 2, *line* 8, *for* of, *read* in.
p. 112, *col.* 1, *line* 2, *for* had, *read* have.
p. 112, *col.* 1, *line* 5, *for* would, *read* will.
p. 187, *col.* 2, *line* 12, *for* Burley, *read* Burnley.
p. 138, *col.* 1, *line* 8, *for* $\frac{Am}{A}$, *read* $\frac{Am}{Aa}$.
p. 203, *col.* 2, *line* 9 *from bottom*, *for* answers, *read* answerers.
p. 204, *col.* 1, *line* 5, *for* Price, read Brice.

[We cannot allow the preceding paper to go to press without a remark or two which the subject forces most painfully upon our attention. In one of a series of articles in the *Philosophical Magazine*, by Professor Davies (under the title of "Geometry and Geometers") he has made some remarks on the cultivators of geometry in this country having been, till very recent times, chiefly non-academic men; and he states that "Messrs. Lowry and Whitley are the only two representatives of the old English school now left us." We think he is in error as regards Mr. Lowry, and that Mr. Whitley stands the sole representative of a host of geometers unknown to *general fame*; but not surpassed in the number and brilliancy of their investigations by the same number of men in any age, who cultivated science under the auspices of royalty, or in the cloisters endowed by the pious munificence of our devout forefathers. It is a painful reflection, that the last of an honoured race is now an old man; and that there is not another prophet waiting to catch the mantle of his intellectual eminence.

But this is not all. The aged geometer has a cheerless prospect for his closing days. The entanglement of a Chancery suit totally ruined his worldly prospects, and though he has struggled like a man and a Christian with his adverse fate—we blush to say that whilst he is unfitted for all employment, he is left without the slightest token of the consideration of his labours by his country. The Charterhouse, which would be a suitable asylum for his few remaining years, is thought to be better employed by its Governors as a convenient means of pensioning off their own aged servants! The £1200 a year pension on the civil list is not applied to such cases as his, but to those in which a man's talents have been employed to subserve a political party, or from which a certain degree of *éclat* may be derived by the Government itself. Nay, literature and science both have, in some years, been shabbily dealt with by the Government; and, as a general rule, science has fared much worse than literature. *Our* Government never tries to find out the deserving; and it is useless for any one to press the claims of such a man as Mr. Whitley upon the attention of the Minister, except he possess political influence, to purchase which may repay the bestowal of the pension! Shame on such a system! and shame on any minister, and on the "patrons" of all benevolent institutions (such as the Charterhouse) that do not rescue such a geometer from impending destitution.

We shall, ere long, return to the subject of the distribution of literary and scientific pensions—a system as entirely corrupt in its management as any one that has yet been exposed to public condemnation.—ED. M. M.]

IMPROVEMENTS SUGGESTED IN TREENAILS AND CAULKING.

Sir,—Valuable suggestions may remain long unfruitful till approximated. I here propose to approximate Bentham's treenails and Jeffery's marine glue.

It is well known, first, that copper bolts are expensive; second, that copper and iron bolts exposed are liable to rust

and decay; and, third, that all three are liable to *draw*. Hence, *the starting of butts*, and the loss of the ship!

This disastrous result, I opine, can be entirely obviated by the employment of treenails, dipped before using in Jeffery's marine glue. They would thus be rendered *part and parcel* of the plank and beam, while it would be all but impossible for them to draw. In those cases in which the treenails penetrated the parts, they could be secured still farther by a little wedge at the further extremity as used by carpenters. This wedge, also, should be dipped in the glue. Thus employed, wooden treenails would be lighter, cheaper, and far more efficient than iron or copper bolts.

I would also discontinue the present dirty and inefficient system of caulking. Caulked seams, as every one who has been to sea knows, are very often not water-tight, they consequently afford no bond. I would substitute thin wooden wedges, slightly notched on their flat surfaces, dipped in the marine glue and driven home. These would stick hard and fast, keep out the wet, and need little or no repair.

I am, Sir, yours, &c.,
H. M'Cormac, M.D.

Belfast, Sept. 3, 1848.

THE RIVAL LIQUID MANURE CARTS.

Sir,—The last communication of Mr. Baddeley fairly lets the "cat out of the bag." In his first letter he sent you impugning the award of the Agricultural Society's medal to Messrs. Deane, Dray, and Deane, for their liquid manure distributing cart, not a word was said of there being any better machine of the sort in the field. Mr. Baddeley professed to be actuated solely by public motives! He had no private interests of his own, or of any friend, or employer of his, to serve by his censures! Oh, no! But when pressed to assign a rational ground for his hostility to Messrs. Deane, Dray, and Deanes' machine, he asks you to look at this other machine of his friend, Mr. Crosskill—as if that were reason sufficient for damning everything else. Is that a fair or manly course of proceeding? Who is Mr. Baddeley that he should expect his mere decision on this or any other subject to pass for gospel? If his presumption be based upon his natural sagacity or scientific attainments, need we go further than to your last Number for a proof of the value to be assigned to them, in which Number we see it gravely propounded by this gentleman that the potato disease is owing to the number of steam-engines.*

Messrs. Deane and Co.'s cart was devised for the purpose of raising liquid manure by means somewhat more facile than the liquid manure carts before in use, and it is found far to exceed the anticipations regarding it, and to possess properties respecting the lifting of the manure which no other liquid manure cart can compete with; so much so, that the manure does not pass through a valve or through the pump, and can therefore be drawn up into the cart although in a thickish state. It was for this property that the Agricultural Society awarded the prize. Messrs. Deane, Dray, and Deane had previously other liquid manure carts divided and partitioned like that described by Mr. Baddeley, and with distributors for spreading the manure on the land. One of these, through an inaccuracy in the entry, was not allowed to compete, although at the Agricultural Show. Perhaps your correspondent did not know of this, because it served the purpose of a *farm fire-engine* as well as a watering and liquid manure cart. An engraving and description of which was given in the *Mech. Mag.*, No. 1302, p. 75. With this communication I shall drop the subject; for, like yourself, I cannot see either the force or point of your correspondent's *arguments* and *surmises* against the convictions arising from practical experiments.

I am, Sir, yours, &c.
S. B. Milne.
Engineer.

THE HOOKAH SYSTEM OF VENTILATION.

Sir,—It strikes me that the novel ventilation (Turkish Hookah Ventilator,) the principle of which I some time since set forth in your Journal, would be well calculated to remove the "smoke nuisance." I observe —but only since the thing occurred to me—that it has been loosely adverted to,

* Of which very sensible demonstration this is a necessary corollary, that where steam engines abound most, there the potato disease should be most rampant; of the truth of which corollary again the present state of things in Ireland (in many counties of which there is not a single steam chimney,) affords a curiously felicitous and most opportune illustration!

without giving me any credit, by Mr. Godwin (see *Builder*, Aug. 26, p. 411.) In place of ventilating the *inside*, it would be ventilating the *outside* of the house.

Suppose the chimney of a furnace made to descend a little, then to take a *syphon turn*, after which to come back and pass *through the fire*. The syphon turn I would supply with water to be periodically renewed. Or a second and smaller fire could be made in the course of the funnel; but this second fire would itself smoke. I would, therefore, prefer the first plan. The funnel, I conceive, would be sufficiently heated to create a partial vacuum, and cause the air to be thoroughly strained and purified, to pass through the water.

I am, Sir, yours, &c.,

HENRY M'CORMAC.

Belfast, September 9, 1848.

ORSI'S PATENT IMPROVEMENTS IN ARTIFICIAL STONE, CEMENTS, ORNAMENTAL TILES, BRICKS, AND QUARRIES.

[Patent dated March 22, 1848. Patentee, Joseph Orsi. Specification enrolled September 22, 1848.]

The patentee employs, firstly, for the manufacture of an artificial stone, suitable for building, paving, and other purposes, the following composition of materials, to which he gives the name of brown metallic lava:—

Gravel or stone broken into small pieces, 3 parts; pounded chalk, 2 parts; tar, 1 part; wax, 1-10th.

The tar is first melted in a cauldron, and the wax, gravel, or broken stone, chalk, and mineral colour are successively added. The artificial stone or metallic lava thus formed, is cast in moulds, either into solid blocks of any required form, or into hollow vessels, as troughs and tanks. It is also made into pipes, in manner following:—A circular core or rod of wood, and of the length and diameter of the proposed pipe, is enveloped in paper, or other suitable substance, to prevent the lava adhering to the roller, and rolled over a flat table covered with the lava in a warm and fluent state, till it has taken up a good coating of the lava; three or more iron ribs are then attached lengthways, and at equal distances, to the half-formed pipe, by winding wire round them; and when this has been done, a second coating is added, by rolling as before, and of thickness sufficient to cover the iron ribs and wire. The pipe being now completed, is set aside to cool, after which the wooden core is withdrawn.

Secondly, the patentee employs for the manufacture of ornamental tiles, bricks, and quarries, another combination of materials, to which he gives the name of "ornamental metallic lava," and which is composed as follows:—

Ground flint, 2 parts; marble broken into small pieces, 3 parts; resin, 1 part; wax, 1-10th part, and some mineral substance to give, as before, the required colours to the lava—as, for example, cobalt for blue, yellow ochre for sandstone, red ochre for red granite, &c., 2-10th parts.

The modes of preparing this lava, and of casting it of various forms, are similar to those before directed to be followed in preparing and casting in the brown lava. When it is desired to produce an ornamental tile, brick, or quarry according to any particular pattern or device, and in various colours, the following proceeding is adopted:—

Supposing, for example, the tile is to be made in four pieces inclosed one within the other, each of a circular polygonal or any other arbitary form, and colours respectively of (1) blue, (2) yellow, (3) red, and (4) grey. The blue piece (1) is first cast by itself in a suitable mould, and allowed to cool. It is then taken from the mould and placed in the centre of the mould from which the yellow piece (2) is to be cast, and the yellow lava of which the latter is to be composed, poured in round the blue piece. The blue and yellow pieces (1 and 2) which have been thus united together are next transferred to the centre of the mould, from which the red piece (3) is to be cast, and the red lava of which the latter is to be composed poured round the blue and yellow. And, finally, the triple pieces of the yellow and red are placed in the centre of the mould, from which the outside piece of grey (4) is to be cast, and the tile completed by the addition of the grey lava. These pieces are all cast on a flat iron with their surfaces undermost which are intended to form the top surface of the tile when in use; and for the sake of economising the materials of which they are composed, each casting is made from about half an inch to an inch only in thickness. Requisite thickness and strength is afterwards imparted to the tile by giving the whole a backing of the brown lava first hereinbefore described, which is poured on in a warm fluent state. When the tile has set and become cold, it is ground and polished on its upper surface in the ordinary manner practised by marble workers, that is to say by a flat stone, sand, and water.

And, thirdly, the patentee manufactures an excellent cement from either of the combinations of materials before described; observing only to reduce the materials to as comminuted a state as can be conveniently done, and to apply the cement in a warm state.

GUTTA PERCHA WORKS.

We lately visited the extensive works belonging to the Gutta Percha Company, in Wharf-road, City-road, and confess that we were delighted and astonished. The premises in which the business of the Company is carried on, cover a large area of ground. Several floors of the building are devoted to the operations of the workmen, amounting to nearly 170 individuals, including a sprinkling of stout, hearty-looking boys. The basement is occupied by two steam-engines, without whose presence the works would be by no means complete. These groan from "early morn till dewy eve," in turning lathes in the engineering department, in kneading the gutta percha, cutting out soles and heels for boots and shoes, rolling out driving-bands of every dimension, and heating the steam-chests, by which the gutta percha is rendered pliable and fit for the hands of the workmen. On the principal floor there are several powerful hydraulic presses, used in the process of manufacture; and we had the good fortune to witness the production of a complete dessert service of the most chaste and elegant pattern, and in imitation of gnarled oak. The subjects of adornment were brought out in high relief, and after undergoing the process of varnishing, were surprisingly beautiful, light, and incapable of being fractured or broken by a fall or a blow. Some of these sets were of the vine-leaf pattern, in close imitation to nature. These things were pressed out with some rapidity, but not without great manual labour, notwithstanding the aid of the powerful presses alluded to. Inkstands of the most beautiful character were also fashioned in a short time; indeed, all sorts of ornaments, elaborated with the most ingenious devices, were made during our stay. We observed a vast deal of ornamental work, intended to supersede the labour of the carver. There were frames of large dimensions ready for the reception of pictures. We were particularly struck with the appearance of one intended for a large pier-glass. The foliage was of the most sumptuous workmanship, and possessed a sharpness and finish which the hand of man could scarcely accomplish. A design for a Bible-cover was exhibited. The subject harmonized with the nature of the book it was intended to enclose, and was in bold relief. It is believed that gutta percha will, in a short time, be in general use among bookbinders, not only in the shape of massive covers, but to supersede the present cotton binding, which has so pretty an appearance, but is not of that lasting character as to induce persons to adopt it in cases where strength and durability are required. In other portions of the factory, workmen were employed in making instruments used by surgeons, to be employed in cases of a delicate nature; others were finishing off the numerous objects just turned out of the moulds. Amongst the articles of curiosity, we observed several yards of gutta percha rendered exceedingly thin by machinery, and intended for ladies' dresses; it was of a light pink colour, by no means displeasing to the eye, and possessed of great strength. By the aid of delicate machinery, the gutta percha was run out into thread, to be used in the manufacture of ladies' work-bags, fishing-nets, and for a hundred other purposes. Large tubing, and some with an inconceivably small bore, was run out to lengths of various dimensions. Wagon and cart harness, of enormous strength, combined with lightness, we observed hanging up in the establishment, besides gentlemen's riding whips, and thongs of every kind. Greatly as we were delighted with all these things, we had yet another treat to come, which infinitely surpassed anything we had seen. We were shown several specimens of enormous panelling, in imitation of ancient oak, on which the carving of the original design was brought up with remarkable fidelity. Considering that gutta percha is an indestructible material, we have little hesitation in stating, that the mansions of the nobility will soon be decorated with ornamental work produced by this new system of multiplying objects produced by the ancients to their glory and eternal honour. —*Weekly Dispatch.*

APPLICATION OF GUTTA PERCHA TO THE INSULATION OF ELECTRIC WIRES.

Gutta Percha Company,
Wharf-road, City-road,
London, Sept. 19, 1848.
Gray's-inn.

Sir,—In your last Number, I find a proposition by Mr. Hammerton, of the Electric Telegraph Company's establishment, for inclosing wires in gutta percha. I beg to inform you that, on the part of the Gutta Percha Company, several plans have been adopted for the above purpose, among others, that of inclosing the wires in small tubes: this I have done very successfully, and exhibited a specimen at the late Meeting of the British Association. I am, Sir, &c.,

FRANCIS WHISHAW.

ON THE APPLICATION OF GUTTA PERCHA AS AN INSULATOR OF ELECTRIC WIRES.

As Mr. Alexander Bain is at this time engaged in introducing his numerous and important improvements in electric

telegraphs in the United States of America, he will not for some time have an opportunity of seeing Mr. Hammerton's letter, at page 273 of your last Number. Under these circumstances, therefore, I must beg your insertion of the following statement relative to the subject matter of Mr. Hammerton's communication, viz., on the application of gutta percha as an insulating medium for electric wires. It is now about six months ago that, in consequence of some preliminary experiments upon the insulating power of gutta percha, which were entirely successful, I suggested its use to Mr. Bain, for the purpose of effectually insulating the wires of the electric telegraph; whereupon he informed me that he had for some time past employed gutta percha for that purpose, and found it in every way to answer his most sanguine expectations. He mentioned several modes in which he had used this singular material, and described, among other things, an arrangement which he had perfected for enclosing the wire within a solid seamless tube of gutta percha, in such a manner as to ensure the central position of the wire throughout—a matter of considerable importance.

Mr. Hammerton now *proposes* to cover the wire with gutta percha, fitting close to the wire, "either with or without a join along the sides; the latter, though rather more expensive, being doubtless the best plan." By Mr. Bain's process, I believe the latter plan is not more expensive than the other. If I remember rightly, Mr. Bain at the same time told me that the fitness of gutta percha, as an insulating medium, had occurred to many different persons.

Perfect insulation of the wires is a matter of vital importance to electric telegraphs, and one in which the public generally are greatly interested, inasmuch as whatever tends to diminish the expense of working, will cheapen the cost of transmission (at present decidedly too high,) and thereby materially extend the usefulness of this wonderful agent.

Your readers have before them the statement of the superintendent of the Electric Telegraph Company, that "the most serious obstacle to the transmission of signals by electric action, is *the want of perfect insulation;*" and that "in towns it is necessary to lay the conducting wires under the streets; for this purpose they are placed in leaden tubes, which are enclosed in iron pipes; but *the insulation is very defective.*"

This certainly is no more than the truth, the fact being, that the state of the few hundred yards of wire forming the line between Euston-square and the central station of the Electric Telegraph Company in Lothbury, can only be regarded as a practical libel upon the present state of electrical science in this country, and reflects but little credit upon the heads that planned or the hands that executed it. The selection of the plan there adopted, from among so many better and cheaper modes that were open to the Company, argues a woful deficiency of talent in their engineering department. This comparatively short line of wires has already produced much annoyance, and entailed considerable expense upon the Company—a state of things which may be expected to continue until the whole is taken up and relaid with more care upon some better system.

Gutta percha promises, at a moderate cost, to effect the most perfect and permanent insulation, and may, ultimately, be extensively employed for that purpose. To Mr. Hammerton, however, cannot be conceded the sole merit of having first discovered the peculiar fitness of that material for such a purpose.

I am, Sir, yours, &c.,

WM. BADDELEY.

29, Alfred-street, Islington, September 19, 1848.

THE USE OF GUTTA PERCHA FOR ELECTRO-TELEGRAPHIC PURPOSES.

Sir,—In the last Number of your Journal, I find a letter from Mr. Hammerton, the Superintendent of the Central District of the Electric Telegraph Company. In this letter he submits a plan for the better insulation than any hitherto attempted.

Now, I think that on inquiry Mr. Hammerton will find that in February last gutta percha tubes of the same shape and length were used in Kilsby Tunnel (North Western Railway) partly at the suggestion of Mr. Physick, the Telegraph Company's engineer. These tubes were introduced for the better protection of the India rubber covered wires used in this tunnel, which is very wet, and were placed at all points of support. These tubes having proved efficient, they have also been put up in Leighton, Watford, and Kensal-green Tunnels, and I believe in some of the tunnels on the Midland lines.

As to the use of gutta percha for insulating wires, whether in the form of a band

or in separate tubes, the application has already been patented by the chairman of the Electric Telegraph Company.

I hope that the insertion of this letter will not encroach too much on your valuable space, and I remain, Sir, yours, &c.,

Z. U.

London, Sept. 19, 1848.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Robert Walter Winfield, of Birmingham, merchant and manufacturer, and John Ward, of Birmingham, aforesaid, a workman in the employ of the said Robert Walter Winfield, for certain improvements in the manufacture of tubes, and in the manufacture of certain articles made in part of tubes. September 14; six months.

William Sager, of Rochdale, wool dealer, for certain improved means and apparatus for effecting the transit or conveyance of goods, passengers, and correspondence by land or water, and for other such purposes; part or parts of which means and apparatus constitute a new and improved method of generating steam, which improvement is applicable to other purposes to which steam is generally applied as a motive power. September 15; six months.

Joseph Lillie, of Manchester, engineer, for certain machinery or apparatus applicable for purifying and cooling liquids, and for purifying, condensing, and cooling gases. September 21; six months.

John Frearson, of Birmingham, machinist, for improvements in bending or shaping iron or steel, and other metals. September 21; six months.

Henry Wilson, foreman to Messrs. William Greaves and Son, of the Sheaf Works, Sheffield, for improvements in the manufacture of chisels and gouges. September 21; six months.

William Brown Roof, of Stanhope-street, Regent's-park, chemist, for certain improvements in the construction of respirators. September 21; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Sept. 14	1586	Francis Pastorelli	Cross-street, Hatton Garden	Wheel barometer.
"	1587	Elizabeth Middleton & Margaret Rettie	London	Sanitary urinal, or air trap, for preventing effluvia.
16	1588	John Brecklies	Castle Mills, Oxford	Brush for dressing flour.
"	1589	Frederick Walton and Co.	Old Hall Works, Wolverhampton	Torricellian shower bath.
19	1590	Ephraim Smith	Carlisle-street, Soho	Spring swivel or hook.

CONTENTS OF THIS NUMBER.

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Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

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Edited by J. C. Robertson, 166, Fleet-street.

MESSRS. M'CONOCHIE AND CLAUDE'S IMPROVEMENTS IN LOCOMOTIVE ENGINES.

Fig. 1.

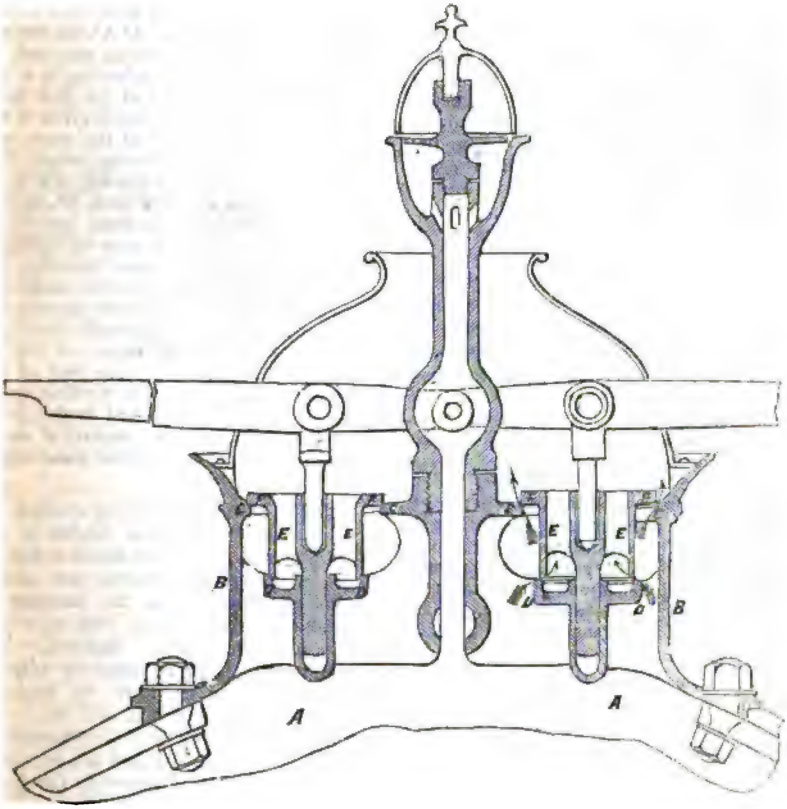
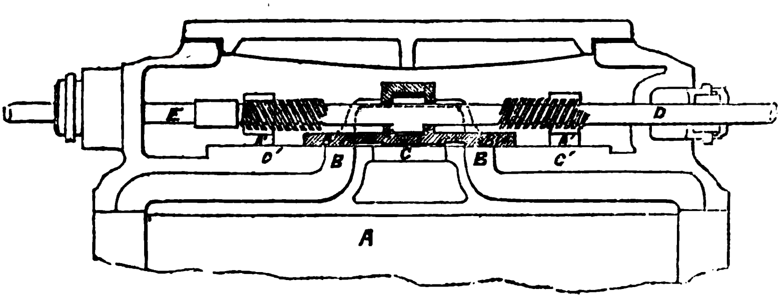


Fig. 2.



MESSRS. M'CONOCHIE AND CLAUDE'S IMPROVEMENTS IN LOCOMOTIVE ENGINES.

SECOND NOTICE.

We now proceed to describe the several substantive improvements which we mentioned in our last had been made by Messrs. M'Conochie and Claude in different parts of the locomotive engine.

(1.) The first we shall notice is a very clever contrivance called a "double beat safety valve," which is so formed, that with the same amount of lift and the same strength of spring attached to the lever, as the safety valves now in use, a much greater area is obtained for the escape of the steam, and consequently greater security from danger of explosion. A longitudinal section of a pair of safety valves constructed on this plan is given in figure 1 of our present illustrations. One of the valves is represented as being open, and the other closed, and the passages for the escape of steam are indicated by the arrows.

A A is the boiler; B B, the valve casing; C C, the upper valve seats; D D, the lower valve seats; E E, the valves which are of the form of a hollow cylinder with conical terminations. At top these conical terminations are enlarged into flanges, F F, in which the barrels of the valves terminate. The pressure of steam effective in lifting the valve depends upon the area of the annular ring formed by that portion of the flange, F, which projects beyond the barrel of the valve, it being the only portion of the valve which remains unbalanced against the steam pressure.

It will be obvious, that by this arrangement a safety valve may be made with a greatly increased area for the escape of steam compared with those now in use, without involving the necessity of any increase in the weight, or strength of spring required to indicate the degree of pressure obtained by the steam in the boiler. This safety valve has, moreover, the advantage of effecting its intended purpose with a very short rise of the valve.

(2.) A second improvement consists in combining with the ordinary slide valves of locomotive engines two sliding throttle valves, placed directly on the steam port face of the cylinder, whereby the admission of steam into the cylinders may be regulated to the utmost nicety, and consequently with the greatest possible economy, without at all interfering with the freedom of action of the exhaust ports, or requiring any enlargement of the steam passages. The details of this new combination are represented in fig. 2.

A is the cylinder; B B, the steam ports; C, the exhaust port; B^1 B^1, the ordinary slide valve; C^1 C^1, the cylinder facing; E, the spindle, by which the slide valve is connected to the eccentrics; A^1 A^1, are the two slide-throttle valves, which are mounted on a spindle D, which has its bearing in a recess formed in the body of the slide valve B^1, so that whatever motion is given to the slide valve they partake of the same, and move along with it to the same extent. The length of each of the throttle valves is equal to the breadth of the slide valve, B^1, so that when they come over the steam ports they may still have a bearing upon the cylinder facing. A greater or lesser throttling action is effected, by simply turning round the spindle, D; one of the throttle valves being connected to it by a right-hand screw, and the other by a left-hand screw, so that as the spindle is turned the one way or the other, the two valves are simultaneously brought nearer to, or pushed further from the slide valve, and the quantity of steam admitted at each stroke of the piston regulated accordingly.

(3.) The next improvement to which we have to direct attention, relates to the fire-box, and has for its object a reduction in its weight without any corresponding reduction in the amount of effective heating surface. Of this improvement the patentees observe, "We consider it to be more especially adapted to such engines as have no trailing-wheels, but no doubt it will be found more or less applicable to locomotives of every description." Fig. 3 is a sectional elevation of their improved fire-box; and fig. 4 a cross-section of it on the line *a b* of fig. 3.

A is the fire-box, which is rounded off at the top in the manner shown, the rounding off commencing below the door, B, through which the fuel is supplied, and being carried up towards the crown, C D; D is the water space; E, one end of the barrel, or cylindrical part of the boiler; and F the space occupied either with a flue or more generally with the tubes. L, is a longitudinal midfeather which occupies a central position in the fire-box, and is open to the water space, D D, both at back and front. The bottom of this midfeather, L, is about twelve inches from the upper surface of the fire-bars, so that the area of the fire-grate is not diminished thereby in the least. So

also the upper part, *f*, of the midfeather, next the tube plate, is cut away in order that the number of tubes may not be decreased by the introduction of the midfeather.

(4.) To enable the barrel of the boiler to be brought much lower than at present, Messrs. M'Conochie and Claude propose the following alteration in the position of the cranks of the axle of the driving wheels, and in the mode of attaching the axle to the wheels.

Fig. 3.

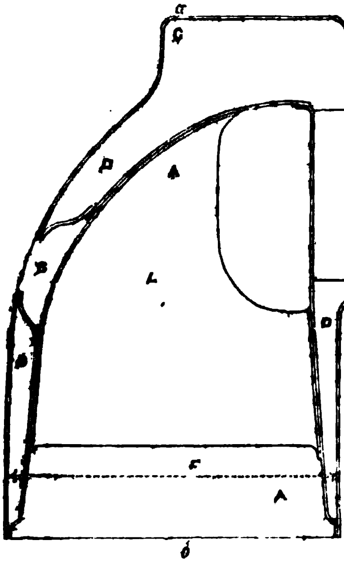


Fig. 4.

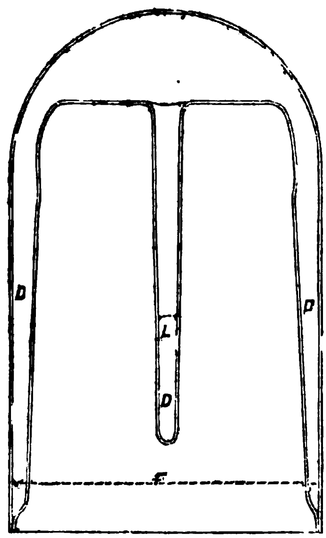
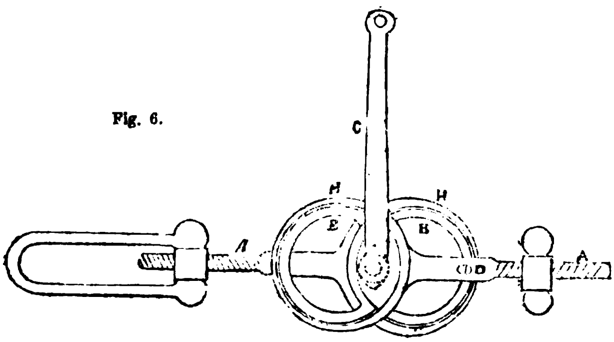


Fig. 6.



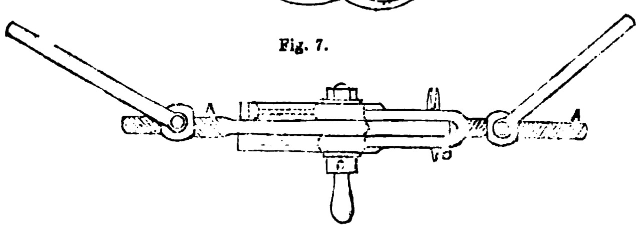
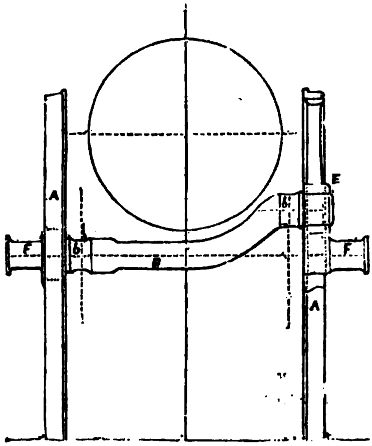


Fig. 7.

A A (fig. 5) are the wheels; B, the crank-shaft. The cranks, *b b*, are put as usual at right angles to each other, but occupy positions much nearer to the wheel than usual; and instead of being returned, so that the third side of the crank may be brought

down to enter the central boss or eye of the wheel, D, it is inserted in a supplementary boss, E. FF are journals, which occupy the place in the central boss usually assigned to the end of the crank-shaft, and serve as bearings to the engine. (These journals may be made in one piece with the wheel.) By this arrangement we are enabled to place the axial line of the cylinder further apart, (that is to say, by all the thickness of the two outside cheeks of the crank) and consequently to have the barrel of the boiler proportionably low.

Fig. 5.



(5.) For feeding the boilers, the following improved arrangement is adopted: The feed-pump, as stated in our last notice, and as will be seen by reference to the figures which accompanied it, are placed outside of the driving wheels. The piston-rod is attached by a connecting rod and pin to one end of the axle of the driving wheels, or to the nave of one of the wheels, and the connecting-pin occupies a position sufficiently eccentric to produce the length of stroke required to be given to the pump; and, instead of the ordinary conical seated, or lifting valves, a valve is made use of similar to the slide-valve of a steam engine, which is worked by a rod attached to a crank formed on the end of the connecting-pin.

Messrs. M'Conochie and Claude specify some other contrivances which may be considered rather in the light of useful appendages to the locomotive engine than as improvements in the engine itself.

The most striking of these is a plan for facilitating the adjustment, *while the engine is running*, of the portion of weight borne by the wheels respectively; but this improvement, it must be observed, is applicable to such engines only as are provided with six or more wheels.

A toggle joint is placed intermediate between the bearings of the axles of the trailing wheels and the springs of the carriage (which are immediately over them,) and connected by joints to the engine frame and springs. A rod connects the knuckle of this toggle joint to the piston rod of a small steam cylinder, which is connected with the boiler by means of a pipe, upon which there is a stop-cock. When the driver wants to increase the weight borne by the driving wheels, he has only to open the stop-cock, which will allow either steam or water from the boiler to enter above the piston, and this will, of necessity, draw the toggle joint into an upright position, and so cause the weight of the locomotive to come more upon the driving wheels, and to reduce, in a corresponding degree, the weight upon the trailing wheels. And to produce the opposite effect, the driver has but to allow the steam or water to escape from above the piston, and go into the reverse end of the cylinder.

Messrs. M'Conochie and Claude propose also the following clever means of stopping or checking the progress of an engine and train in cases of danger of collision, or generally where it is desirable to reduce the rate of speed:—

A series of tubes lead from the steam boiler underneath the tender and carriages, and are interlocked with one another, in manner to be afterwards explained. The engineer has at his command a cock, by which he can in an instant admit steam into these tubes or shut it off. The steam, when so admitted, may be made to actuate in various ways breaks placed between the wheels. For example, it may be conveyed by a branch pipe into a small vertical working cylinder, and made there to press a piston upwards, so as to throw out two breaks (connected with the piston,) one against the front wheel and the other against the hind wheel; or it may be made to act directly upon the breaks themselves; or it may be made to act on a weighted lever break, through the medium either of a horizontal cylinder or of a vertical one. Each length of tubing is made of a receiving form at one end, and of an entering form at the other. The former is widened considerably at the mouth; and just at the point where it begins to be widened, an annular spring, made of vulcanized caoutchouc, is inserted in a seat made for it on the inside of the tube, and made fast thereto. Before the entering tube is inserted, the face of the annular spring projects slightly beyond the

inner periphery of the receiving tube; but, on that tube being pushed in, it presses back the annular spring, which afterwards closes tightly upon the entering tube, and forms a perfectly steam-tight joining. The different lengths of tubes are thus joined together by simply thrusting the one into the other; an operation which takes up but little time, and requires no skill whatever. And when the driver sees occasion to stop or check the progress of a train, he can instantly, without losing time, or communicating with any one, let on the steam, and bring all the breaks of a train into simultaneous operation.

Another very useful invention of this supplementary class, consists of a new mode of connecting railway carriages together, by which the necessity of the tedious process of slacking back, in order to ease the coupling sufficiently to enable it to be detached from the hook, is completely obviated. Fig. 6 is a side elevation, and fig. 7 a plan of this improved coupling.

AA are screws, such as are ordinarily employed in such couplings; HH, hoops, which are forged on to the ends of these screws, for the purpose of affording bearings to three eccentrics, BBB; D is a pin, which locks these eccentrics; and C, a lever, by which the eccentrics are worked. The mode in which this coupling is used is as follows:—The pin, D, being taken out, and the lever, C, pulled down half a circle, the coupling is expanded by the action of the eccentrics to an extent sufficient to allow the coupling to be lifted over the hook to which it is attached.

Before concluding, we must not forget to notice that Messrs. M'Conochie and Claude, in addition to the numerous improvements of which we have given an account, describe in their specification two plans for adapting oscillating cylinders to locomotive engines; of which it may be sufficient to say, that the chief object aimed at in both, is to bring the oscillating or vibrating parts upon which the steam more immediately acts, as close as may be to the driving-wheels, and thereby to prevent any oscillation arising from the overhanging weight of the cylinders.

ON THE PRINCIPLES OF ALGEBRA, AS A SYSTEM OF GENERAL REASONING; WITH A SKETCH OF ITS RECENT PROGRESS, AND A REFERENCE TO SOME RECENT PAPERS IN THE "MECHANICS' MAGAZINE."

(Continued from page 297.)

It will be worth while here to bring forward the objection on which they principally rely who doubt the *legitimacy* of those conclusions arrived at by means of symbolical algebra. (The *truth* of these conclusions is doubted by no one, but only the evidence of the method by which they are deduced.) This objection is, that we attempt to get more out of the conclusion than we put into the premises, so that the theorem is at first obtained solely on the supposition of a and b being numbers, and then interpreted afterwards, and made to apply to what are not numbers. In short, that a and b are numbers, and nothing but numbers in the axioms and postulates, and, therefore, must remain numbers throughout the process and in the final result. This objection does three things:—(1.) Makes a supposition, which is not true in that sense which alone affects the present question, viz., the supposition that a and b are *considered to be numbers* in the premises, or axioms and postulates on which *we* now-a-days found the theorem. The objector tacitly, however, but really is referring to the notions with regard to a and b held by those who first discovered the theorem, and by beginners at the present day, who are mentally in the same condition—the *arithmetical condition*, if one may so term it.

(2.) The objection founds on this supposition a charge of logical error, which *would be* true *if* the supposition itself were true. The error, namely, of giving to a and b a wider signification in the conclusion than we gave to them in the beginning.

(3.) The objection involves itself a logical error, though of a different nature from that which it alleges: namely, that because A is deduced from B, it can be deduced from nothing else but B. For, it supposes that, because the binomial theorem was originally deduced on the supposition of a and b being numbers, it cannot be deduced from any other supposition. There are two ways of showing the falsity of this: one (which may

be called the analytical way) already referred to, namely, by examining what are and what are not the *essential* conditions in the process: the other (which may be called the synthetical way) by actually beginning with a and b on the supposition that they do *not* represent numbers, but some other operations (for instance, the operations of differentiating, usually denoted by $\frac{d}{dx}$, or d^x and $\frac{d}{dy}$ or d^y) and building up the theorem from this foundation. In doing so, of course we are at liberty to retain the original significations of the other symbols, such as $+ -$, and so on. We *might*, if we pleased, give other significations to these symbols also, *providing we combined them according to the same laws as before*, and the binomial theorem would remain unaltered, except that now we should have a totally new *interpretation* to make of the meaning of the final result or equation, or rather of the terms composing the two sides of the equation.

It is possible that the objection here mentioned may be tacitly, and perhaps unconsciously, made with reference to certain "proofs" of the binomial theorem, which are really open to it, either through limited views in the author of such proofs, or inaccuracy in his phraseology. Just as Bishop Berkeley charged (and probably with truth) some of the mathematicians of his day, with the logical error of first supposing dx to be *something*, and after reasoning *on this supposition*, turning round and considering the said dx to be *nothing*. An incautious mode of expression, no doubt fully justified this accusation of Berkeley, although the writers so charged either might or might not entertain correct views of *the thing* so inaccurately expressed.

With regard to the various proofs of the binomial theorem, I cannot look upon what is called "Euler's Proof" as at all likely to give any clearer notions on the subject to one who meets with it for the first time in the ordinary course of reading. It appears to me impossible to convey satisfactory ideas, as to the extension of the theorem from positive integral indices to fractional and negative ones, without at the same time, in fact, going so far as to give a general view of the principles of symbolical algebra. Neither can the idea of what is meant by "the permanence of equivalent forms," be fully seized without obtaining, at the same time, these general views. In passing from the binomial theorem for positive integer values of the index to others, the one idea which should first be prominently brought forward, is that of the *change of interpretation of the symbols*, even though the learner should still persist in considering them as *numbers*—this change of interpretation being in fact perfectly consistent with such a restricted view.

In the course of the preceding remarks frequent mention has been made of using symbols, without attaching any definite meaning to them. It may appear strange to say that symbolical algebra, which is an algebra in which no particular signification is attached to the symbols employed, is a system of *reasoning*. The question will naturally be asked, "How can we reason about what we don't understand?" The following extract from Dugald Stewart will at once enable every reader to answer the question for himself.

"Take, then, any step of one of Euclid's demonstrations; for example, the first step of his first proposition, and state it in the form of a syllogism. 'All straight lines drawn from the centre of a circle to the circumference, are equal to one another. But AB and CD are straight lines drawn from the centre of a circle to the circumference. Therefore AB is equal to CD.' It is perfectly manifest that in order to feel the force of this conclusion, it is by no means necessary that I should annex any particular notions to the letters AB or CD, or that I should comprehend what is meant by *equality*, or by a *circle*, its *centre*, and its *circumference*. Every person must be satisfied that the truth of the conclusion is necessarily implied in that of the two premises; whatever the particular things may be to which these premises relate. In the following syllogism too: 'All men must die; Peter is a man; therefore Peter must die;' the evidence of the conclusion does not in the least depend on the particular notions I annex to the words man and *Peter*; but would be equally complete, if we were to substitute instead of them two letters of the alphabet, or any other insignificant characters. 'All Xs must die; Z is an

X, therefore Z must die;' is a syllogism which forces the assent no less than the former. It is further obvious that this syllogism would be equally conclusive if, instead of the word *die*, I were to substitute any other verb that the language contains; and that in order to perceive the justness of the inference, it is not even necessary that I should understand its meaning. In general it might be easily shown that all the rules of logic, with respect to syllogisms, might be demonstrated without having recourse to anything but letters of the alphabet; in the same manner (and I may add on the very same principles) the algebraist demonstrates, by means of these letters, the various rules for transposing the terms of an equation. From what has been said, it follows, that the assent we give to the conclusion of syllogism does not result from any examination of the notions expressed by the different proportions of which it is composed, but is an immediate consequence of the relations in which the words stand to each other. The truth is that in every syllogism, the inference is only a particular instance of the general axiom, that whatever is true universally of any sign, must also be true of every individual which that sign can be employed to express." ("Philos. of Mind," Part I., chap. iv., Section 2.) This last sentence of Stewart's is almost of itself an explanation of symbolic algebra.

The experience of every one who has gone through the usual elementary course of mathematics, illustrates this peculiar nature of algebra. The constant complaint of every learner—and especially of those who do not commence till after the schoolboy age—is that he does not *understand* what he is about in algebra. In geometry he does. In the most intricate questions of political economy the learner is not free from *this* source of embarrassment. In spite of himself and his arithmetical predilections, he cannot escape from the consciousness that he is *mechanically putting symbols together*, and the very fact of the absence of all (necessary) signification in these symbols is exactly what troubles him the most. Whenever he is anxious to convince himself that any algebraical transformation is *true* (for example that $(a+b)^2=a^2+2ab+b^2$.) he substitutes numbers for the letters. There is a constant struggle to *understand* what is in reality not a subject for the exercise of the understanding. It would be easy enough to construct an algebra-working machine; all that it would have to do being simply changing the relative positions of some letters or types, taking away some and putting others in their place, and so on—the whole being done in accordance with some three or four laws of combination, the same laws or "rules" which equally regulate the proceedings of the student and the machine. So far, then, algebra is in its very nature a mechanical and non-understandable process; and to attempt making it otherwise would be in fact to destroy its very existence. Those who are but slightly acquainted with mathematics will be very apt to conclude that if these observations are true, algebra cannot be made a subject for the exercise of the intellect at all. It will be no easy matter, to make them comprehend the connection between what is essentially mechanical and what is essentially pure argument or reasoning. Many will be confirmed in this conclusion by remembering the effect produced on them by some of the older books on algebra, after their bewilderment and despair amongst the modern treatises. These *older* books they "*could understand*," whereas in the latter everything was to them sheer juggling with letters. And yet such persons cannot but be conscious, on reflection, that arithmetic itself—their beloved science—is itself to a very great extent *purely mechanical*. Take for example a long multiplication sum; is not the process carried on by mere mechanical attention to certain laws or rules? Aye! and the figures are to all intents and purposes *mere symbols* to the mind of the operator (or may be so) and he combines them just as in algebra, in accordance with some three or four laws which he has learnt to use and attend to. So little does the schoolboy (or anybody else who has not come back to the consideration of the subject expressly for the purpose of *understanding*) think of the *signification* of what he is doing, or the real nature of the operations in which he is engaged, that when he is told for the first time that multiplication is in reality nothing but successive addition, and division nothing but successive sub-

traction, it is to him a new idea—or at any rate one of which he had only indistinct glimpses before.

But further; the symbols 1, 2, 3, 4, 5, 6, 7, 8, 9, what do they signify? What meaning do you attach to them? Examine your notions clearly, and it will be found that they involve the idea of *operation*—a purely mental operation, certainly; namely, that by which certain *relations* are perceived. It is utterly impossible to attach any idea to the symbol 3 without reference to something else. A picture, or any ordinary word, such as "tree," for instance, may stand for some one object, and convey an idea to the mind without reference to any other idea. But these numerical symbols can do nothing of the kind.

Leaving aside these purely mental operations, however, we assert that arithmetic is a "calculus of *operations purely conventional and arbitrary*"—not hereby implying, by any means, that the *truths* of arithmetic are either conventional or arbitrary. Very little need be said to prove this, since every one knows that the signification we attach to any figure, depends not only on its form (such as 4), but on its *relative position* with regard to the surrounding figures, if there are any; so that it may stand for four, or forty, or four hundred, &c. In our arithmetic, this purely conventional and arbitrary notation is one of those rules or laws of combination of the symbols to which, as in algebra, the operator has to pay constant attention—this attention, in fact, constituting a great part of his work. Some of the single symbols themselves represent the *results of operations*; 8, for instance, representing the product of 2 and 4. Other such results are represented by conventional arrangements, such as 12.

All these things, of course, are obvious enough; but if they give the notion of "conventional and arbitrary modes of operating on symbols," which yet lead to useful and important results—a great advance will be made towards the comprehension of the nature and utility of symbolical algebra. A tolerably good notion of these may be conveyed, too, by the following considerations:—Any one can understand that one series of operations may *have the same result* as another series of operations (the operations being either mental or physical, and even manual). He can understand, too, that in many cases it may be advisable and convenient to employ one of these series rather than the other, and that it may frequently happen that the desired result *can* only be attained by one of these series, inasmuch as we are unable, through some cause or other, to perform the other series, and that it may thus become desirable (and even necessary to certain ends) to investigate from the very nature of the operations themselves *what series or combination of them are equivalent; i. e.*, produce the same final result. The knowledge of which equivalence, enables us to substitute possible for impossible operations (that is *impossible* not in their own nature, but impossible to us through present incapacity or ignorance).

Those who understand the subject will perceive that I have here been, in fact, describing the nature and advantages of algebra, in which, to take an example, it is shown that such an operation as that denoted by x^{m+n}, may be replaced, without affecting the result, by another series of operations denoted by $x^m \times x^n$.

(To be continued.)

LAPOINTE'S WATER-GAUGE PIPE.

[Abstract of Report of MM. Poncelet, Piobert, and Morin to the French Academy of Sciences.]

The importance of this subject, in the application of water as a moving power for machinery, or other practical purposes, will be understood by all who are aware of the difficulty of ascertaining, with the requisite degree of precision, the quantity of water expended under variable circumstances, during a given period of time. The different results produced by a particular arrangement of the apertures; a change of rapidity in the revolutions of the wheels; a variation of the level in the head and fall; and other modifying causes,—are such as to show that it is by no means easy, exactly to appreciate them in experiments upon the effect of water power.

An apparatus which would, by the mere inspection of an index, and the application of a simple form of calculation, give at once the quantity of water flowing through a known orifice, in a given time, would be a contrivance of great utility to engineers and others charged with, or interested in, the application of hydraulic science to ascertain practical effects. Many attempts have been made to solve this problem, most of which have been directed to the deter-

mination of the mean velocity of the fluid in a section of known surface, thence deducing the volume of the flow. M. Lapointe proposes to ascertain immediately, and without other measurement than the inspection of an index, the quantity of water flowing through any aperture, and under all circumstances.

According to the description given by the committee, the apparatus used by him consisted of a cylindrical pipe, furnished with a little wheel with helicoidal wings, the axis of which corresponded with that of the pipe, and which gave motion to an index placed above the water, and within sight of the observer. The tube, widened at its mouth in a form similar to that of the contracted vein issuing from a circular aperture, is fastened, by means of a flanch and bolts, to the dam of plank which prevents the passage of any water except through the pipe. The axis of this pipe is horizontal, and it is placed so low that its upper edge may be always beneath the level of the water below the dam, which will, in all cases, ensure a full flow from it.

The wheel is placed in the axis of the pipe, and at such a distance from its mouth, that the parallelism of the filaments of water may be established by the time they reach it. The axle of the wheel imparts movement by a bevel gearing to a very light vertical spindle which rises from the pipe, above the level of the water, and moves an index, by which, when the apparatus is at work, the number of revolutions made by the wheel, in any given time, may be determined without stopping or changing the motion.

It will be readily perceived that when there is a difference of level between the water on opposite sides of the dam, there will be a current passing through the pipe, and that the wheel will begin to turn as soon as the action of the current overcomes the passive resistance of the apparatus. The velocity of the wings, or the number of revolutions made by the wheel, increases, then, with the difference of level, or with the expenditure of water, according to a law which was left to be determined, by direct experiments, whether it was sufficiently simple to render the application convenient and certain.

For this purpose M. Lapointe made the following experiments at one of the races of the powder works at Bouchet. The outlet of the face, where it emptied into the general canal of discharge, was closed by a dam of planks, in which were made three apertures, each being three-tenths of a metre square, and encased with sheet iron. Gates, also of sheet iron, were worked by screws, so as to allow, in each experiment, of the passage of all the water which presented itself, and thus to maintain a constant level above the bottom of the orifices. The flow through these apertures, the edges of which were sharp,—the contractions complete entirely around them, and which were very similar in arrangement and dimensions to the apertures studied by Messrs. Poncelet and Lesbros,—may be estimated by the results obtained by these practised observers.

The gauge tube was placed in another dam, at a sufficient distance from the former, and above which a constant level was established and maintained during each experiment.

The control and constancy of the levels being thus acquired and ascertained, it was certain that the gauge pipe and the little measuring gates delivered equal volumes of water in the same period of time. One of the observers remained near the little gates, to be certain that the level was constantly maintained; while the other took post at the gauge pipe, to observe the number of revolutions made by the wheel per minute; using for that purpose one of Breguet's counters.

In the first experiments, of which the results are given by M. Lapointe in his memoir, he operated in this manner with constant levels: the differences in the height of water above the dam, and that below it, being comprised between ·06 and ·24 metres.

Now, taking for abscissas the volumes of water expended in a second, and for ordinates the corresponding number of revolutions of the wheel,—he has shown that all the points thus determined fall upon the same straight line, which intersects the axis of the abscissas in advance of the origin of the co-ordinates. From which he concludes: 1. That the movement of the wheel does not commence unless there flows, in a unit of time, a certain volume of water: and, 2. That for the different volumes of water discharged in a unit of time, the increase in the number of revolutions of the wheel is proportional to the increase in the volumes expended.

The law, therefore, which connects the number of revolutions with the corresponding volumes of water expended in a unit of time, may, when the rule is established, be represented by the simple equation of a right line, $Q = a + bn$;—in which Q represents the quantity of water discharged in a second; a and b the constant numbers furnished by the observations, and which, for the wheel used, have the following values: $a = {\cdot}0635$ cubic metres; $b = {\cdot}01247$ cubic metres;—and n the number of revolutions in a second.

In comparing the results of this practical formula, Q = ·0635 cubic metres + ·01247 *n*, with those of the direct observations, it was found that the greatest variation of the result of the formula from that which was furnished by the observations, at the gates, was $\frac{1}{40}$ of the latter; and this difference, which is sometimes in excess and sometimes in defect, should be rather attributed to errors of observation at the gates, than to the instrument itself.

It was therefore established, by these first experiments, in which the volumes dischared per second varied from ·131 to ·372 cubic metres, that, when the discharging and receiving levels continued constant, the above formula will enable us directly to calculate the expenditure, by knowing the number of revolutions made by the wheel. But as in these experiments the operations were successively conducted at different velocities, it was natural thence to conclude that the relation between the velocity of the water, or the expenditure, and the number of turns of the wheel, was independent of that velocity,—or, that the co-efficients *a* and *b* of the formula were independent of the velocity;—and that consequently this formula ought to apply, with the same accuracy, to the measuring of water when the velocity was variable, as when it was permanent. This last consideration greatly extended the utility of the gauge pipe, inasmuch as it rendered easy the measurements under variable levels, and enabled observers to avoid one of the principal causes of error in experiments upon water power.

However plausible might be this conclusion which M. Lapointe had drawn from his first experiments, he rightly conceived that it was necessary to verify it by special experiments. For this purpose, and in order at the same time to extend the field of his observations, he obtained from the able engineers who have the direction of the Paris water works, authority to fix his apparatus between two of the great basins of Chaillot, the regular form of which is favourable to gauging by direct measurement of the volumes.

A trench of 1·40 metres in width, by 1·80 in depth, was made between the two reservoirs, and extended in the lower basin by a wooden trunk of the same size and about five metres in length; making the total length of the conduit about nine metres. At the entrance of this conduit is a gate, by means of which the flow of water from the upper to the lower basin may be regulated at pleasure. Below this gate was placed the dam to which was attached the gauge pipe previously employed at Bouchet. A second dam, placed at the outlet of the conduit, allowed the water of the lower level to be kept at a convenient height above the extremity of the pipe. The water which passed over the dam fell into a trough, in which were placed inclined planes to conduct the water down gently, that it might fall into the basin without causing too great an agitation of the surface.

A wooden float, so large as to be little affected by the waves on the surface of the water, sliding on a rod graduated to every five centimetres, was used for determining the elevation of the level.

The steam pump at Chaillot raises but about 140 litres of water in a second; but, on account of the excess accumulated in the reservoir, much more than this quantity could be used in operating with variable heads of water. At the commencement of a series of experiments, the upper basin was full, and the lower one almost empty; there was then a strong head, and the pipe discharged more than the pump supplied; in consequence of which the level above the pipe was reduced, as well as that below it; but the former more than the latter. The moving power, therefore, being equal to the difference of the levels, was constantly diminishing, until the pipe discharged but about 140 litres,—the flow and the supply being then brought to a permanent condition.

Ingenious arrangements having been made to that effect by the author, the observations of the height of level in the lower basin,—of the corresponding time,—and of the index showing the number of revolutions performed by the wheel,—were all made readily and simultaneously by the same person. In order to account for the difference in the values obtained for the constants of the formula in these experiments, it should be observed that the wheel and index used, had been altered in their proportions from those used in the first experiment.

These new experiments, to the number of 68, made under conditions of movement varied with the heads of water giving the velocity comprised between ·01 and ·435 metres, were graphically represented like the preceding, and in like manner showed that the relation between the volumes of water expended, and the number of revolutions of the wheel, is expressed by the equation of a right line. But here, in consequence of the changes made in the proportions of the wheel and the index, the values of the constant coefficients of this equation are *a* = ·024, and *b* = ·02203 cubic metres, which leads to the practical formula for calculating the flow per second, Q = ·024 + ·02203 *n*; or, if the observation be continued during a period expressed in seconds by *t*, then Q = ·024 *t* + ·02203 *n*, in this case *n* being the whole

number of revolutions during the time *t*. The discharges observed having been comprised between 77 and 423 litres in a second, it will be perceived that they varied nearly in the ratio of 1 to 5·5.

Two of the committee caused several of the experiments to be repeated. These were made indiscriminately with full and medium heads of water, and the results obtained agreed perfectly with those observed by M. Lapointe.

Another gauge pipe, intended for the discharge of a larger quantity of water, with a diameter of ·70 of a metre, was also tried at the basins of Chaillot. A series of 33 experiments, in which the difference between the upper and lower levels varied from ·03 to ·23 of a metre, and the expenditure from ·8158 to ·2338 cubic metres, verified anew the proportionality of the discharges to the expression of the form $a+bn$. The graphic representation of the results gives for the constants a and b, the values $a = \cdot 014$, and $b = \cdot 0478$ cubic metres, and consequently, for the practical formula, $Q = \cdot 014 + \cdot 0478\,n$.

The general result of these experiments is, that the gauge pipe, wheel, and index of M. Lapointe, furnish a simple, expeditious, and accurate means of determining the quantity of water which passes through the tube, either under constant or variable heads. Its application is not more difficult than that of any other method of measuring by dams, and is not subject to the same uncertainty. When the tare of the instrument has been once carefully established, it will at once give the volume of water desired to be known.

The diameter of the pipe being only limited to a size which will admit of being readily placed in the proper position; it will be perceived, that by means of one or two pipes of this kind, streams of water may be measured which deliver several cubic metres per second. Such an apparatus would be of great utility in experiments relative to the employing of water power, in situations where the measurement is attended with many difficulties, and occasionally gives rise to disputes. But whatever care the author may have bestowed upon the determination of the practical formula, by the aid of which the discharge is computed, it is proper that this determination, which consists in what may be called the *tare* of the instrument, might be examined and verified in the presence of the parties interested, if there be a question in dispute;—and to this effect the author proposes to study the ratio which connects the number of revolutions with the pressure of the head of water in constant levels, by which he will be able to make this verification.

It was suggested by one of the committee, that a highly useful application of M. Lapointe's apparatus might be made by employing the wheel and index themselves, to limit and regulate the volume of water discharged by the pipe, independent of the time and the variation of level. Thus modified, the apparatus would become a real *water meter*, which would be of important service in the supply and distribution of water to cities; and above all, in cases where water is to be shared or divided between parties.

On the whole, the committee conclude that the gauge pipe of M. Lapointe is convenient in practice, and that it supplies a quick and sufficiently exact means of measuring the flow of a stream; and therefore proposes that it should receive the approbation of the Academy. The conclusions of the report were adopted.

PAUL'S PATENT EXCAVATOR AND DRAIN-CUTTING MACHINE.

Sir,—Your readers will doubtless sympathise with Mr. James White, the first patentee in England of a drain tile-making machine, whose case of neglected merit appears in your last Number (page 277). He is, however, but an unfortunate individual of a very numerous class, who seem born but to "serve their generation, and then to fall asleep." The road to which Mr. White pointed, "and led the way," has been well trodden. So much so, that drain tile-machines have become a staple manufacture, and abound in every exhibition of agricultural matters. Nor has an improved method of forming the drain, wherein to lay the pipes, been overlooked. Several applications of ploughs adapted for that peculiar work have been made, with considerable success. More recently a machine for that purpose has been invented and patented by Mr. Joseph Paul, of Thorpe Abbotts, Norfolk, which promises to supersede all others.*

There would be considerable difficulty in using an instrument constructed agreeably to the plan submitted by Mr. White at page 277, besides which, it requires a plough to excavate the earth after the side cutting has been effected by the proposed machine; in Mr. Paul's ma-

* "For improvements in cutting or forming drains in land, and for raising subsoils to the surface of land. Sealed, July 29, 1847.

chine, the drain is cut, and cleared out by one operation. At the Annual Meeting of the Central Suffolk Agricultural Association, held at Stowmarket on the 7th instant, there was an excellent collection of agricultural implements exhibited; after describing some of the more striking, the *Ipswich Express* adds,

"But, perhaps, the apparatus which excited the greatest interest consisted of two models of newly invented implements, one of which was constructed for subsoiling, and the other for cutting drains. Both were worked by windlasses set to work by horse power. The inventor, Mr. Joseph Paul, of Thorpe Abbotts, Norfolk, stated the machine for subsoiling would go over half an acre for drains to the depth of from two to two and a half feet, in a day. The machine for cutting drains consisted of a revolving wheel with projecting scoops, and was capable of cutting to the depth of 4 feet, at the rate of 4 feet per minute, equal to raising 20 tons of clay per hour."

I hope hereafter to be enabled to lay before your readers a detailed description of this instrument, which displays much ingenuity in its adaptation to the particular and variable kind of work required of it.

I remain, Sir, yours, &c.

WM. BADDELEY.

92, Alfred-street, Islington, September 18, 1848.

ON THE THEOREM OF LEIBNITZ. BY PROFESSOR YOUNG, OF BELFAST.

Resuming the developments of $(1+x)^m$ and $(1+x)^n$ in the communication which I presume appears in the *Mech. Mag.* of this month;* we may thence deduce a series for the coefficient of any power, x^r, in the development of $(1+x)^{m+n}$. For this purpose we shall only have to write the terms of one of the former developments in reverse order; arranging them so that the term involving x^r may fall under the leading term of the other development, and then to multiply vertically, as before; thus

$$(1+x)^m = 1 + mx + \frac{m(m-1)}{2}x^2 + \frac{m(m-1)(m-2)}{2.3}x^3 + \ldots Px^r + \&c.$$

$$(1+x)^n = \ldots\ldots Ax^r + Bx^{r-1} + Cx^{r-2} + Dx^{r-3} + \ldots\ldots\ldots (1.)$$

so that we shall have, for the coefficient of x^r in $(1+x)^{m+n}$, the series

$$A + Bm + C\frac{m(m-1)}{2} + \ldots . P = \frac{(m+n-r+1)(m+n-r+2)\ldots(m+n)}{2.3.4\ldots . r}$$

This process has suggested to me an easy method of establishing the theorem given by Leibnitz for the rth differential coefficient of the product of two functions.

The original investigation of it is in the *Commercium Epistolicum* of Leibnitz and Bernoulli, a work which I have not seen; so that I am unable to say in how far this method and that of Leibnitz may agree.

Let the functions be u and v: then, changing the variable x, supposed to be involved in them, into $x+h$, and marking the several differential coefficients, with their numerical divisors, as supplied by Taylor's theorem, with accents, we have, for the developments of the changed functions, as far as necessary, the two series

$$u + u'h + u''h^2 + u'''h^3 + \ldots\ldots u^{(r)}h^r + \&c.$$

$$\ldots\ldots v^{(r)}h^r + v^{(r-1)}h^{r-1} + v^{(r-2)}h^{r-2} + v^{(r-3)}h^3 + \ldots\ldots v,$$

therefore, multiplying vertically, we have for the rth differential coefficient of uv, when divided by the numerical product $2.3.4\ldots r$, the series

$$uv^{(r)} + u'v^{(r-1)} + u''v^{(r-2)} + u'''v^{(r-3)} + \ldots u^{(r)}v,$$

and, consequently, removing the numerical divisors, by multiplying every term by $2.3.4\ldots r$, and using the ordinary notation, we have

$$\frac{d^r(uv.)}{dx^r} = u\frac{d^r v}{dx^r} + r\frac{du}{dx}\,\frac{d^{r-1}v}{dx^{r-1}} + \frac{r(r-1)}{2}\,\frac{d^2u}{dx^2}\,\frac{d^{r-2}v}{dx^{r-2}} + \ldots\ldots\ldots\ldots \frac{d^r u}{dx^r}v,$$

* See *ante* p. 270.

which is the theorem of Leibnitz. In Gregory's examples, p. 13, where this theorem is quoted from Leibnitz, the final term is not exhibited as I think it should be; since a learner might not perceive that $\frac{d^0 v}{dx^0}$ means v.

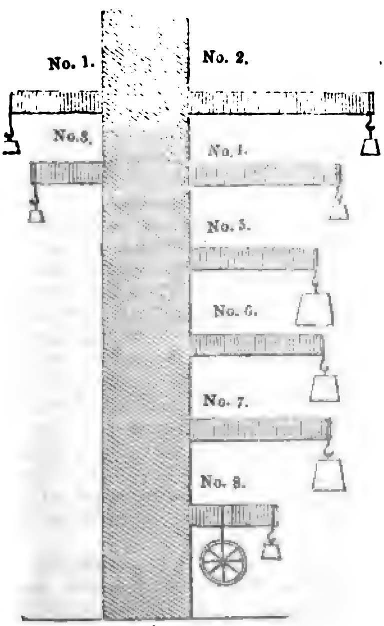
Belfast, Sept. 16, 1848.

THE NEW "PORTLAND CEMENT."

A good deal of attention has recently been directed to a new patent cement, called "Portland cement," manufactured by Messrs. Aspden and Robbins, of Northfleet. On Monday last, a number of architects, builders, and other persons interested in the constructive arts, assembled, by invitation, at the town premises of these gentlemen, in Great Scotland-yard, to witness a series of experiments, having for their object to test the value of this cement as compared with the best cements in common use. The following is a statement, illustrated by diagrams, of the principal results obtained on the occasion. The bricks used throughout were stock bricks of the first quality.

In experiment No. 1, seventeen bricks were successively attached, in a horizontal position, to a vertical wall, by means of Roman cement, and broke down on attaching to the extreme end of the series a weight of 7 lbs.

Experiment 2. Thirty-eight bricks were attached to the wall, in like manner, by means of the patent Portland cement, and did not give way till twice the weight was applied at the end, which sufficed to break down less than half the



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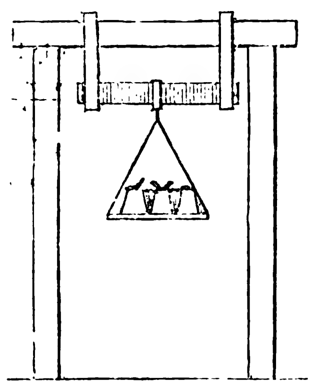

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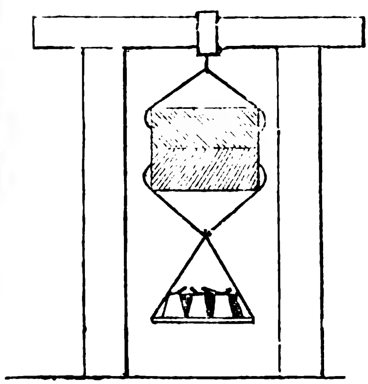


number of bricks in the preceding experiment.

3. Eleven bricks, attached by means of a mixture of Roman cement and sand, in equal parts, broke down with a weight of 7 lbs.

4. Thirty bricks, attached by a mixture of Portland cement and sand, in equal parts, broke down with 15 lbs.

5. With a mixture of 2 parts sand and 1 part Portland cement, 22 bricks broke down with 168 lbs. at end.

6. Mixture of 4 parts sand and 1 Portland cement; 25 bricks broke down with 56 lbs.

7. Sand 2 parts, Portland cement 1; 26 bricks broke down with 74 lbs. at end.

8. All Portland cement; 14 bricks broke down with a wheel weighing 9 cwt. and 17 lbs. additional at the end.

9. Sixteen bricks, mixed 1 and 1, broke with 15 cwt. in the scale.

10. A block of Portland stone, 2 feet 11 inches by 9 inches square, broke at 38 cwt.—*Note.* A block, cemented with Roman, would not bear the weight of the stone in a similar position.

The following trials were made in an hydraulic press:—

A block, all Portland cement, 18 ins. high, 9 × 9, sustained a pressure equal to 108½ tons on the square foot.

A mixture, 1 sand and 1 cement, sustained 80 tons on the square foot.

A mixture, 4 sand and 1 cement, broke at 80 tons on the square foot.

A mixture, 7 sand and 1 cement, broke at 44½ tons on the square foot.

A block, all Roman cement, broke at 22½ tons.

A mixture, 4 parts sand and 1 Roman cement, would not bear any pressure.

A block of Portland stone, 1½ in. by 1 in., broke up at 23 cwt.

A block of the Portland cement, of the same size, broke with 18 tons.

ON THE RELATION BETWEEN NUMBER AND FORM. BY IATRO-MATHEMATICUS.*

Sir,—Your readers will, I am sure, feel greatly obliged to me for having called forth the remarks (full of the deepest interest) of Ex-Reviewer. But I think this profound mathematician's reply to my humble suggestions, rather the agitation of the *previous question*, than of the one I took the liberty of proposing for the consideration of the more youthful portion of your readers.

There are persons who call a^2, a^3, a square, a cube; and others who speak of them as the second, the third power of a, or as a to the power of 2, 3, &c. I think some idea of a square, a cube, however obscure, exists in the mind of the former, and however that idea may deserve to be rooted out, still it does exist. Now, Sir, it is precisely for these persons, these "*crutched*" ones, and for these only, that my suggestion was offered. It struck me that if they were aided in their conception of the second and third powers of numbers, by such an idea, they might be aided still further in the more difficult conception of the fourth, the fifth, the sixth powers, &c., by observing that these *repeat* the line, the square, the cube; and that these latter are repeated in the seventh, the eighth, the ninth power, &c.; leading from primary to secondary, tertiary, quaternary systems of these figures without limit.

The superstructure will have precisely the degree of stability of the base; and this, I fear, "Ex-Reviewer" has proved to have none at all. Still with the addition and security of "Ex-Reviewer's" commentary, what I have suggested, may be viewed as not without interest and utility to the uninitiated,—may "teach the youg idea how to shoot," and may serve as a crutch, if not as a wing, for the weak and unpractised. It is curious at the least, that the second, the fifth, the eighth powers of a number, may be "packed together" in the form of squares, and the sixth, the ninth, the twelfth, may be "packed together" in that of a secondary, tertiary, quaternary cube.

Another good will arise from this commencement of a correspondence. I and others shall be led to study those former papers of "Ex-Reviewer," to which he refers, and the learned works of Professor De Morgan, &c., of which he speaks so highly.

As to those who obstinately speak of the second and third powers, and as obstinately reject the other phreaseology (for this they must do to be consistent,) I fear I must leave them and their able

* This paper having been shown to "Ex-Reviewer," he has added a note,—which, whilst it concludes the discussion, also adds some useful suggestions of a general nature which naturally flowed out of it.—Ed. M. M.

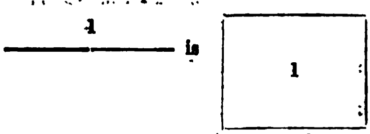
general, "Ex-Reviewer," on "the field of their glory" in the possession of victory.

But when it is admitted, that there is not an essential, but merely a conventional, connection between number and magnitude, and that the notion of position is "simply one of packing together in an implied order;" it may still be a question whether this notion is worth pursuing, such as it is, and whether it assists the understanding, or development of truth—just as a mere hypothesis often leads to discovery.

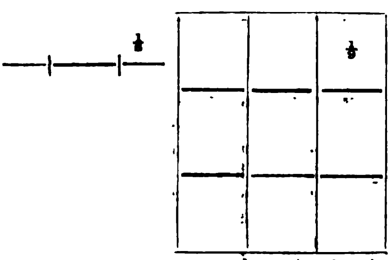
I beg, too, to add another example of the use which may be made of this mode of viewing the hypothetical connection of form and number.

The young student is puzzled on being told that the square of 1 is 1. He cannot imagine how any number and its square should be the same. They are not the same in fact. The expression should be, the square of 1 linear, is 1 square.

Thus, the square of



Now this 1 may be expressed by any number or any fraction—thus, the square of $\frac{1}{3}$ is $\frac{1}{9}$th



That is, the square of one-third of a given line is $\frac{1}{9}$th of its square.

And thus, whilst the square of all numbers from 1, go on increasing, that of all fractions from 1 go on diminishing.

And thus the term multiplication is a misnomer, and only applies to whole numbers; the result is the reverse when applied to fractions. It consists in reducing that which was linear to a superficies, and as the former has a *reference* to the *line* the latter has *reference* to its *square*.

If two unequal numbers or fractions are multiplied together, the *reference* of the product is to *two* squares, those of the two original numbers or fractions respectively; and so also of a single fraction of which the numerator is greater than 1.

Without venturing to disagree with "Ex-Reviewer," I may nevertheless be allowed to add, that it would be difficult to find another case, in which coincidences, not essential, are so numerous and extraordinary, as well as useful.

I am, Sir, your obedient servant,

IATRO-MATHEMATICUS.

London, September 10, 1848.

Note by Ex-Reviewer.

It does not appear, after all, that there is much difference between the final views of Ιατρομαθεματικος and myself. I had, however, understood him to mean that the relation was *essential*, whilst I viewed it as an *accidental analogy*. Too much reason exists for believing that these analogies are liable to be mistaken for identities; and that a property proved with respect to pure algebra is often considered sufficient evidence of the truth of a property of a purely geometrical character. Sufficiently striking instances of this may be readily quoted; but it will be sufficient to allude to two of them. The first is Legendre's celebrated attempt to establish the doctrine of parallels by the solution of a functional equation (*Géom.*, *note* ii.), and in the validity of which he was a firm believer to the last. (See also, *Leslie's Geometry*, p. 296.) The other is the system which, originating in France, has become the fashion at Cambridge, of deducing a complete system of trigonometry without the adoption of a single geometrical theorem as its basis. Seeing such things as these, and the Germanizing tendency that is growing up amongst us (after the fashion of Dr. Oken*) to found all science on mere analogies supposed by the builder to exist between mathematics and all other physical and mental phenomena :—seeing this, I say, I was fearful that the illusion would spread even over the development of our earliest principles of mathematics, if the real character of the relation were distinctly pointed out. As an *analogy*, nothing can be more beautiful, or more neatly laid down, than what has been done on this question by your distinguished correspondent.

It is, however, by no means uncommon to

* Some specimens of Oken's method of philosophising may be seen *ante* vol. xlviii., p. 17.—ED. M. M.

find analogies of this kind in mathematics; but they generally make their appearance in a more advanced stage of the science. For instance, how often do we meet with sin θ, cos θ, &c., in the course of our integrations of expressions which were purely numerical in their hypothesis? Nay, even in the doctrine of chances, we meet with such expressions as $e^{\cos. x}$; and in physical science—in cases too where the *geometrical relations* are not the objects of research—we find different trigonometrical functions amongst the results.

Why is this? The relation which the *forms of expression* imply, is surely not an essential one amongst our ideas of the things expressed. It is simply accidental.

When we meet with such an expression (to take as simple an instance as possible) in the course of our inquiries respecting an algebraical problem, as

$$\int \frac{dx}{1+x^2};$$

then viewing it simply as an algebraical inquiry, we should have it expanded into

$$\int dx\,(1-x+x^2-x^3+\ldots)$$

or, integrating term by term, into

$$x-\frac{x^2}{2}+\frac{x^3}{3}-\frac{x^4}{4}+\ldots$$

But by totally independent researches directed to a totally different purpose, it is also found that in trigonometry

$$y=\tan y-\frac{\tan^2 y}{2}+\frac{\tan^3 y}{3}-\frac{\tan^4 y}{4}+\ldots$$

If, then, we put x for tan y in this, and designate the arc whose tangent is x by $\tan^{-1}x$, there then results,

$$\tan^{-1}x=x-\frac{x^2}{2}+\frac{x^3}{3}-\frac{x^4}{4}+\ldots$$

In virtue of this *accidental analogy*, therefore, and on no other ground whatever, are we entitled to say that

$$\int \frac{dx}{1+x^2}=\tan^{-1}x.$$

Two advantages are gained by this:—

(*a*.) That the result admits of a more brief expression, and is therefore more easily read and written.

(*b*.) That the functions of most frequent occurrence are tabulated for different values of x, through all their possible ranges of value—the logarithmic and circular functions in our ordinary tables, and elliptic functions by Legendre and others—though this subject is far from complete at present.

As long as we consider these accidental analogies to be only analogies, their employment is advantageous; but the great danger to be apprehended arises from our not keeping clearly in view that they are analogies; and then of vitiating the philosophy of science by employing them as means for demonstration, instead of using them for illustration or computation. If we only admit the identity for which it appeared to me that Ιατρομαθεματικος was contending, the entire doctrine of pure geometry may be deduced *à la Legendre* without the slightest reference to our ideas of space—and those of physics, *à la Oken*, without the slightest reference to nature, to experiment, or even to our own minds!

As regards the *duplicity* of our language in mathematics, I fear little can be said in reply to your correspondent's censure. Our terminology is in many cases "vicious;" and it is a vice which leads to many misconceptions—it is the old logical sophism of an "ambiguous middle term." Language never keeps pace with discovery; like political governments it follows when compelled, but never leads the way. Physiology and natural science in general have the advantage over the rigorous and contemplative in this respect. The French and German mathematicians, however, coin terms fast enough (sometimes too fast, making a distinction where no difference exists); but in this country there is a tendency to retain old words under new significations, which can, perhaps, only be accounted for by our inhabiting a country which, to use the language of the French Directory, "The sun shines upon with regret." Yours sincerely,

"EX-REVIEWER."

A FEW WORDS IN FAVOUR OF VERTICAL SEA-WALLS.

Sir,—The vast importance of this subject fully justifies the sacrifice of valuable space you have made for it.

I was in hopes that the *horizontal* motion of the sea as an element in the destruction of walls would have been almost dismissed from the discussion.

That the action of the wind *does* produce a horizontal motion in the sea is proved, if such proof be wanted, by the familiar occurrences of extraordinary high tides in our rivers and estuaries, and the accelerated or retarded currents of our inland navigation, when the wind sets strongly for a length of time from particular quarters. But what is the *rate* of such motion,—a motion due to the friction of the air on the surface of the water? Grant it, one, two or extra-

vagantly three miles per hour. Who would fear for the face of a solid pier of masonry built in a river with a current twice as rapid as that.

Any one who has watched either on board ship, or at a pier head, the slow *progress* of floating bodies in a gale of wind will be satisfied that the horizontal motion is insignificant while the disturbance of equilibrium is enormous. And is this not in beautiful accordance with the known properties of fluids?

What then *is* the destructive agent? *Gravity*, I maintain; and though perhaps not strictly that *alone*, yet that in a highly preponderating degree. The blows are only from *breaking* waves—which breaking is caused by the irregular disturbance of equilibrium from the action of the wind. When a vessel is "struck by a sea," it is always, as sailors well know, by a wave *falling* after breaking; *never* by an unbroken wave.

It is at this "breaking," and not till then, that the fearful agent, gravity—fearful when multiplied into so heavy a factor as water—comes into play. The resultant of the forces at work in a breaker is never quite perpendicular to the horizon, and indeed varies much, owing to several obvious causes. It may become even horizontal when turned by impact on inclined surfaces, and the "dead" water below it. Hence the results given by Mr. Stevenson and others. But still the cause is *gravity*.

What surface then offers in the aggregate the greatest opposition? Surely the horizontal or flat slope. What practicable one the least? As surely the perpendicular.

One word in reply to Sir H. De la Beche when he instances the wearing away of vertical rocks on the west coast of Scotland.

Do not these rocks stand on a flat slope formed of their "debris," the intersection of the two planes being just at the heaviest action of the sea—a little below high-water. If so, how different from a wall upright from the bottom of the sea! Is such destruction observable at St. Helena, or other places where vessels can sail up to the rocks? I for one can bear testimony that it is not.

The end and purport of these remarks is this: that practically it is *gravity* alone which gives to the waves their destructive power; that the best attempt to escape the enemy is "not to cross his path more than we can avoid," and that therefore, the vertical wall from the bottom of the sea, or as near it as may be, is the best form.

I am, Sir, yours obediently,

C. S.

Market Raisin, Sept. 21, 1848.

THE PLANET NEPTUNE.—AN ASTRONOMICAL MISTAKE.

The following article dated "Paris, Sept. 15," appears in the *Times:*

"On the 29th ult. M. Babinet made a communication to the Academy of Sciences respecting the planet Neptune, which has been generally called Leverrier's planet, the discovery of it having, as it was said, been made by him from theoretical deductions, which astonished and delighted the scientific public. What M. Leverrier had inferred from the action on other planets of some body which ought to exist was verified, at least so it was thought at the time, by actual vision. Neptune was actually seen by other astronomers, and the honour of the theorist obtained additional lustre. But it appears from the communication of M. Babinet that this is not the planet of M. Leverrier. He had placed his planet at a distance from the sun equal to 36 times the limit of the terrestrial orbit; Neptune revolves at a distance equal to 30 times of these limits, which makes a difference of nearly 200,000,000 of leagues. M. Leverrier had assigned to his planet a body equal to 38 times that of the earth. Neptune has only one-third of this volume. M. Leverrier has stated the revolution of his planet round the sun to take place in 217 years. Neptune performs its revolution in 164 years. Thus, then, Neptune is not M. Leverrier's planet, and all his theory as regards that planet falls to the ground. M. Leverrier may find another planet, but it will not answer the calculations which he made for Neptune. In the sitting of the 14th, M. Leverrier noticed the communication of M. Babinet, and to a great extent admitted his own error. He complains, indeed, that much of what he said was taken in too absolute a sense, but he evinces much more candour than might have been expected from a disappointed explorer. M. Leverrier may console himself with the reflection that if he has not been so successful as he thought he had been, others might have been equally unsuccessful, and, as he has still before him an immense field for the exercise of observation and calculation, we may hope that he will soon make some discovery which will remove the vexation of his present disappointment.

IMPROVEMENT IN THE ELECTRIC TELEGRAPH.

Sir,—During some recent experiments in electricity, I have made several improvements in the present mode of communicating by telegraph, a description of which may prove useful to those engaged upon that work, and in which, though comparatively perfect, much still remains to be effected. The first improvement consists in the form of helix used to induce the deflection upon the magnetic bar. In the old helices, the power decreases in proportion as the force is removed laterally from the centre of suspension of the bar; first, from the inductive effects of the current having a tendency to move the bar around a centre in a right line with its energy, and which, consequently, operates more feebly, as it is further removed from the centre of suspension; and also the extremities of the bar, forming an arc during their deflection, are not always opposed to that portion of the coil presenting the greatest amount of inductive energy. To obviate these defects, the helices which I am using are constructed in such a manner, that the current flows through in a direction at all times parallel to the major axis of the bar, and in a right line with the centre of suspension, thereby exposing the maximum effect of induction from the coil upon the magnet, during the whole extent of its deflection. The form of magnet used is something in the form of the letter S, and is mounted upon a slight disc of box-wood, or other substance; one or more, according to circumstances, working in the form of coil above mentioned, in such a manner as to give motion to a disc of talc on a dial. The disc has the advantage of equigravitation on all sides, and requires a proportionate diminution of power to give the signal, independently of the great advantage arising from a more certain dead beat. The construction of the telegraph is such as to leave the disc independent and free from the magnet and helix, avoiding thereby the many interruptions from contact and other slight causes, and producing a signal more rapid and distinct than even my last improvement of the diamond telegraph, which is now in operation over the whole of the stations belonging to the Electric Telegraph Company.

I am, Sir, yours, &c.,

NATH. J. HOLMES.

Hampstead, September 27, 1848.

MR. CONDIE'S PATENT STEAM HAMMER.

(From the *Glasgow Herald*.)

It is perhaps universally known, that iron can only be made malleable after being brought into the state called pig or cast-iron, by a process of puddling and hammering. This process is necessary that the iron may be cleansed from the scoria or slag, as it is called. In the early history of the iron trade, the hammering was all done by human power, and had the requirements of society remained as they were in such times, the same power might have sufficed. But new wants were continually springing up, and new contrivances to save the exercise of muscles and sinews were found out. Until, however, the invention of the steam engine, the quantity of iron in demand was so small when compared with what it has now become, that the same means which were adequate before the period of that invention, could by no possibility have been made to serve the purposes of the present time. The steam engine, while it provided a means whereby the available force of the world could be increased almost to infinity, made it necessary that the steam engine itself should be brought into requisition to supply materials for the making of more engines. The masses of iron which had to be hammered into a malleable condition for the purpose of saving time and fuel, increased in size, in proportion to the greater size of the machines to which they had to be applied.

Many instruments have been made of enormous weight and power for making malleable iron, but until the invention of hammers, set in action by steam, the supply of iron was exceedingly limited. Immediately after the application of steam, at the puddling forge, the demand for malleable iron rose in even a more rapid degree than in proportion to the increased supply. Many hammers have, from time to time, been invented, but they have all been liable to go wrong—to get out of repair—to damage from breaking, to an almost incredible extent. We may here state a fact in corroboration:—The helve hammers and others of that class, used at every manufactory of malleable iron, have been subject to breakages almost daily since they were first put in action. This liability to injury necessarily caused an immense loss of time and capital, to keep up the tear and wear, and attracted the attention of the great engineer, JAMES WATT, so long ago as in the year 1784. He invented a steam hammer, which, though less liable to go wrong in the same way as the helve and other hammers to which we have alluded, was still liable to serious accidents. Watt's scheme, with certain slight alterations, was brought forward and patented in 1806 by William Deverell, and speedily got of repute.

Not long ago Mr. Nasmyth brought

out and patented a steam hammer, which was similar in principle, and not much different in detail, from both of those we have referred to. Mr. Nasmyth's hammer, which has been four or five years before the public, has failed to give that satisfaction which was expected of it. As a scientific description would be unintelligible without the aid of diagrams, and as it would not, even with the aid of these, be interesting, excepting to a very few of our readers, we will shortly describe the outward appearance of one of Mr. Nasmyth's hammers, and point out what, in our opinion, are its weak points, and which description will, we believe, enable our readers to form an idea of the improvements which Mr. Condie has introduced into his hammer. Mr. Nasmyth's steam hammer is composed of a heavy frame-work of cast iron, not unlike, in shape, to a Jew's-harp, with the head half sunk in the foundation, and the two limbs between which the tongue vibrates directed upwards.

On the top of the two limbs is a stout cross-head frame of cast iron: upon this head piece is supported a cylinder, the upper end of which is nearly thirty feet from the ground. From this cylinder descends a piston-rod, to the lower end of which the ram or hammer is attached, and has a six-feet stroke. This hammer is guided in its upward and downward motion by feathers on the side, moving in grooves in the side frame-work. It is a well known law in mechanics, that when a rod or bar of metal receives a strong blow on one end, the shock is communicated with very little loss of force to the opposite end, and so severe is the shock, that if the percussive force be greater than the power of attraction possessed by the rod or bar, it will be broken asunder near to the end opposite to that which received the blow. This law has no exception. Now, when, as in the case of the Nasmyth hammer, a block of metal is added to the end of the piston-rod, the liability of the piston-rod to break is increased exactly in proportion to the weight of the hammer added to the force of percussion. Such is one of the risks, namely, the fracture of the piston-rod and piston, to which Mr. Nasmyth's hammers are exposed at every blow. The other defects we could point out are principally with respect to the action of the piston on its cylinder, and the difficulty of preventing dangerous oscillation, the first causing leakage of steam from the abrasion of the cylinder, produced by the action of the piston on its sides; the second, causing the piston-rod to twist and bend.

We will now as briefly describe Mr. Condie's patent improved hammer. The frame work of his hammer, which is about fourteen feet high, is not very dissimilar to that of Mr. Nasmyth. Instead, however, of a cylinder standing upon the cross frame at the top of the two side bearers, a piston-rod descends from the head frame. This piston-rod is held by a ball and socket joint to the head frame-work, and the cylinder, to the lower end of which is attached the hammer or ram, moves up and down, supported by the side frames. The steam which gives motion to Mr. Condie's hammer, is fed into the cylinder down through the centre of the piston-rod.

We will now show that Mr. Condie's hammer is at least not liable to the same risks as that of Mr. Nasmyth's. The ram or hammer not being attached to the piston-rod, and the piston and rod being immovable, except in as far as a slight lateral motion is permitted to it by the ball and socket joint to allow for any oscillation which may occur from negligence or wear, makes it all but impossible that either the piston or rod can be effected by the shock while giving the blow. Again, the cylinder and hammer (measuring together about 6½ ft., with grooves in each side), sliding on feathers on the side frames through the whole course of their upward and downward motion, almost entirely prevents oscillation; and the mass of the hammer is so well proportioned to the mass of the cylinder—which is in fact a portion of the hammer—that the shock produced by percussion can never do any damage to either.

We have, since the beginning of March of the present year, when Mr. Condie's first experimental hammer was erected at Mr. Dixon's Govan Iron Works, frequently seen it at work. We have carefully watched the amount of work done by it, and gathered the opinion of practical men as to its efficiency, and the result has been highly satisfactory. It has a stroke of 3½ feet with a weight of 41 cwt.

Those who look upon every mechanical invention in a commercial light, and who calculate the value of a machine more by the profits derivable from it than for the skill evinced in its construction, speak of it in the highest terms. Mr. Condie's hammer has been constantly at work, night and day, since March, and, including scrap furnaces, has kept as many as fourteen puddling furnaces in full work during the whole of that time, and it seems likely to go on safely as long as the material of which it is composed will endure, without rest or accident. During our last visit to the works, while talking with the manager, we put a few questions regarding the value of the work done and

the cost of the instrument, and received the following very graphic and concise answer: —"The tool will pay its own cost in the first year." From what we have seen of it in Govan Iron Works, we are certain that it could keep at least half a dozen more furnaces in full work.

When we remember that Mr. Condie has thrown away the results of his scientific knowledge without advantage to himself in more than one instance, we sincerely hope that he may find in his improved hammer a source of emolument equal to what he might have made by the improvements he added to the hot blast, not to mention any other of his inventions. And while such is our hope, we feel assured that the Condie Hammer only requires to be known to supersede all those which have gone before it.

THE SUSPENSION BRIDGE AT THE FALLS OF NIAGARA.

The best view of the Falls, and one which cannot fail to impress their grandeur upon the mind, is from the deck of the *Maid of the Mist*, a small steamer, which makes several trips daily from the landing near the Suspension Bridge, about two and a half miles below the Falls. You pass in front of all the Falls, English and American, having a perfect view of all from as near a point as safety will permit.

The suspension-bridge just erected over the Niagara river, is in full view of the Falls, and about two and a half miles below. The chasm over which the bridge passes is 800 feet wide, consequently the bridge has a span that length.

The stream, about 400 feet wide, rushes through 230 feet below the top of the banks, with a velocity of 23 or 24 miles an hour, swifter than the fastest steam-boat speed. No boat can cross it there, and the most powerful steamer, headed up stream, would lose ground. Nothing is now complete but the foot bridge, which starting from the level of either bank, rises with a gentle angle to the centre.

The track is 7 feet 6 inches wide, laid with a durable floor of pine boards upon sleepers, 3 by 6 inches scantling, 4½ feet apart. These scantlings are supported at each end by suspenders from the cables. Each suspender is composed of four strands of No. 10 wire, passing around the scantling, and fastened to the cables above, thus forming a double wire rope about the size of a man's finger, and an ample size for security. The bridge is supported by eight wire cables, each composed of 72 strands of No. 10 wire, bound together by smaller wire, forming a rope about an inch and a half thick. These cables are 1160 feet long, nearly a quarter of a mile. They are secured at each end by being firmly anchored in the solid rock 200 feet from the brow of the bank. The towers over which these cables pass stand near the brow of the bank, and are of wood, and 57 feet high. The whole structure, when compared with the immense chasm over which it extends, seems like a gossamer fabric, or spider's web, yet when we consider the strength of the materials of which it is constructed, and the manner in which they are secured, the most timid must feel assured of its strength and durability. It is calculated that it will sustain many times the weight that will ever be placed upon it. The last plank in the floor was laid on the 29th of July, and although the railing is completed only about one third of the way, Mr. Ellett the architect, drove a high-spirited horse over and back, riding himself in the buggy. He then, with equal safety, drove over and returned with a span of horses and carriage, weighing about 3000 lbs. Thus had I the unexpected pleasure of seeing what no man will ever witness again, the first horse and buggy and the first span of horses and carriage that were ever, from creation down to the present time, driven on a bridge over the Niagara.

The bridge, from its immense span and the manner in which it is sustained, waves like thin ice beneath the carriage or the step of the passenger. It is not intended for carriages, but after this trial of its strength none can pronounce it unsafe for pedestrians, and few who visit the place will hesitate from its broad circle to view the Falls above and the mad rush of waters so far beneath his feet.

We traversed it with a feeling of perfect security, and on trying the experiment several times found it took four seconds for a stone dropped from the bridge to strike the water.

The bridge is a beautiful structure. The cost, up to the present time, is about 24,000 dollars. The first cord was carried across by a kite, from the American side, during the prevalence of an east wind, then large ropes, then the cables, then temporary structures, on which the workmen stood to build the bridge. So far no accident attended with loss of life has occurred during its construction. The upsetting of the bridge, which was reported a few weeks since, and by which the lives of some of the workmen were endangered, was of these temporary structures, and not the bridge itself. It is now so braced and supported that it would seem to bid defiance to storm and whirlwind.—*Cleveland* (*U. S.*) *Herald.*

TREDGOLD ON THE STEAM ENGINE—PRACTICAL ENGINEER AND WORKMAN'S EDITION.*

TREDGOLD ON THE STEAM ENGINE has long been our best standard work on the subject, and though many years have elapsed since it first appeared, during which vast advances have been made in the application of steam power, involving an infinitude of practical changes and variations, it still continues with the help of the excellent supplements added from time to time by Mr. Weale in the later editions, to maintain its original reputation undiminished. We have now before us, Part the First of a new, amended, and enlarged Edition, intended more especially for the use of practical engineers and workmen. To bring the work more within the supposed range of the attainments of this class of persons, it is to be stripped entirely of the very learned dress in which it came from the author's hands; all "the Algebraic and Mathematical Calculations are to be rendered into Easy Arithmetical Rules." We feel great curiosity to see how this is to be done (for there is no specimen of the sort in the Part under notice), and are fearful that Mr. Weale has undertaken in this respect more than he will find it easy to accomplish. But if we may assume that the conversion can be effected, there can be no question that the work will be thereby rendered more generally readable, and of course more extensively useful. The work—this new edition of it—is to be published in Sections, each embracing some distinct branch of steam-engine practice, as for example, Locomotive Engines, Stationary Engines, Marine Engines, &c., and each "may be purchased separately," so that persons "will thus be enabled to select those portions which more especially apply to the objects upon which they may be respectively employed." Each Section, too, will contain original supplementary papers, bringing down to the present day, the information relating to the particular branch of the subject to which it is devoted.

The subject selected for the first section, or "DIVISION A," of the work, is the LOCOMOTIVE ENGINE. The first part of this section, which is that now before us, is entirely occupied with a paper entitled "A Complete Set of Rules and Regulations for the Practical Management of a Locomotive Engine, and for the Guidance of Engine Drivers. By John Sewell, L.E." We can hardly be expected to approve of an arrangement by which Tredgold is thus made to give place to L(ocomotive) E(ngineer) Sewell—by which the first part of Tredgold on the Locomotive Engine is presented to us without a word of Tredgold in it(!)—by which matter that ought to have been reserved for a Supplement or Appendix is absurdly thrust into the first and foremost place; but passing these objections over, we have great pleasure in being able to say of Mr. Sewell's paper that it is by far the best which has yet appeared on the subject. Not an engine-driver, nor fireman, nor guard, nor any other person concerned in the practical working of railways, should lose a moment in possessing himself of a copy. It abounds in information and advice, by which one and all of these railway workers may be greatly benefited, and through them the public at large; such information and advice as could only have been furnished by a person of much natural intelligence and sagacity, and himself long and practically conversant with all the details of the difficult subject of which he treats. Mr. Sewell is an honour to the body to which he belongs; and were he but a type of the whole, such a thing as a railway accident (except from sheer negligence or wantonness) would soon be unheard of.

Two splendid engravings are given with this part—one of the eight-wheeled broad-gauge engine, the "Iron Duke," and tender, recently constructed for the Great Western Railway, and the other of Mr. Crampton's patent narrow-gauge engine, built for the North Western Line.

* Tredgold on the Steam Engine; its Progressive and Present State of Improvement; in Divisions; Practically and Amply Elucidating in every Detail the Modifications, and Applications, &c., &c. A New and Revised Edition with considerable additions; in which the Algebraical and Mathematical Computations are rendered into easy arithmetical rules for the Practical Engineer and Workman. With detailed instructions for those employed on Railways and Steam Navigation, in Mining, in Manufactures and Civil Engineering. Part I., 2s. 6d. Weale, 1848.

MR. WEBSTER'S "SUBJECT MATTER, TITLE, AND SPECIFICATION OF LETTERS PATENT FOR INVENTIONS, AND COPYRIGHT OF DESIGNS FOR ARTICLES OF MANUFACTURE."*

The present work is presented to the public as a "supplement" to Mr. Webster's well known "Law and Practice of Letters Patent for Inventions." The matters embraced by it, so far as they relate to patents, are treated under the following heads:—Subject Matter by Statute—Classification of Cases—Amount of Invention—Novelty and Non-User—Utility—Review of Practical Proceedings—The Principle of an Invention—On the Specification.

We need hardly say that anything, on any

* Royal octavo, pp. 100. Elsworth: 1848.

of these topics, from the pen of a barrister of Mr. Webster's extensive practice in patent cases, must be eminently deserving the attention of all who are interested, or meditate being interested, in patent property. His is a voice of authority, not less on account of his great legal experience, than of the mathematical habits of thinking and very considerable scientific attainments, which he has brought from Cambridge, to the aid of his professional pursuits. We would advise every one, however, who reads Mr. Webster's pages, to keep in mind, as he goes along, a fact which the author himself appears to keep rather studiously out of sight, which is this,—that for a great many defects in titles and specifications, which he treats as utterly fatal, there has been a speedy and certain remedy provided by the Act for allowing disclaimers and memorandums of alteration (commonly called Lord Brougham's Act). The author does speak of that Act (p. 76,) but not till after he has gone through and disposed of a great number of cases as if there were no such act in existence. We may venture to say, too—professing to be ourselves not altogether without some insight into the subject matter of the work —that Mr. Webster's dicta are not always such as to command our entire assent, though such always as to be entitled to our most respectful consideration. Let one instance suffice, which we quote the rather, as it is pointed out by the author himself in his "Preface," as of a character singularly apposite to the necessity of his present work:—

"It is by no means uncommon to find a useful invention, instead of being described and classed as a whole, subdivided and frittered away into several heads or claims, none of which are of any value independently, or except in connection with each other as parts of a whole, but each and every one of which, by reason of the form in which they are presented, is open to various objections. Letters patent, so circumstanced, invite attack, opposition, and infringement; litigation is resorted to or resisted, as a means of facilitating arrangements, the terms of which are influenced materially by the character of the title or specification."—*Preface.*

The class of patents, to which these animadversions have obviously special reference, is that very numerous one in which the invention is described as consisting of "certain improvements" in so and so; and the fault of the animadversions is, that they do not take into account that very salutary rule of the existing law, that a patentee shall state specifically what the improvements are which he claims as being of his invention; that he shall separate the old from the new (the wheat from the chaff,) so as to save the lieges the trouble of ascertaining for themselves what parts they are free to use without a license, and those parts for which a license must be obtained. Besides the legal cure pointed out for the defect (if defect it be,) is this; first to claim "the whole" as new in the peculiar arrangement and combination of parts, partly old and partly new, of which that whole consists; and, second, to claim each *new* part by itself, whether employed as a part of the said "peculiar arrangement and combination," or as a part of any other possible arrangement and combination.

The branch of the work which treats of the "Copyright of Designs for Articles of Manufacture," is meagre, and, on the whole, unsatisfactory; which is, no doubt, to be accounted for, in a great degree, by the fact, that the most important of the Designs Acts are of very recent origin, and though they have already done a great deal of public good, have hitherto (happily) given rise to but little litigation. On one leading passage in this division of the work, we must differ, *toto cœlo*, from the author; it is this:—

"It is *not* the design which is the subject of copyright, but the *application* thereof to the articles of manufacture; so that the subject matter of copyright under this Act, is not the design *simpliciter*, but rather the application of the design to the particular articles of manufacture for the purpose of ornamenting such articles."—P. 82.

The best possible way of refuting this view of the law is, to quote the enacting words of the statute itself:—

"Be it enacted that the PROPRIETOR OF EVERY SUCH DESIGN not previously published, either within the United Kingdom of Great Britain and Ireland or elsewhere, shall have the sole right to *apply the same to any articles of manufacture, or to any such substances as aforesaid,*" &c.

To say, indeed, that a person can have a copyright in the application of a thing, but not in the thing itself, seems to us to savour as little of rationality as of law. It is just the same, as if a writer on literary copyright were to argue, that the copyright of an author is not contemporaneous with the printing and publishing of his lucubrations, but begins only when people begin to read them! In this, as in all such cases, the right exists distinct from and independent of all "application." You may not ask or care for a way-leave through my field; but the field is mine, nevertheless.

Mr. Webster states that a new edition of his "Law and Practice" is in the course of preparation; and we are glad to see that he expresses a hope of being "enabled to announce therein an alteration of some of the proceedings connected with the granting of letters patent and the enrolment of the specifications, which most loudly call for amendment."

WEEKLY LIST OF NEW ENGLISH PATENTS.

Robert Stirling Newall, of Gateshead, Durham, for improvements in locks in springs, and in the means of fastening and setting up the rigging of ships. September 28; six months.

Andrew Paton Halliday, of Manchester, manufacturing chemist, for certain improvements in the manufacture of pyroligneous acid. September 28; six months.

Fennell Allman, of Charles-street, St. James's-square, Westminster, consulting engineer, for certain improvements in apparatus for the production of light from electricity. September 28; six months.

William Wilkinson Nicholson, of Acton-street, Gray's-inn-road, civil engineer, for improvements in machinery for compressing wood, and other materials requiring such a process. September 28; six months.

Joseph Gillott and John Morrison, of Birmingham, for improvements in ornamenting cylindrical and other surfaces of wood and other material. September 28; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Sept. 21	1591	Hammond, Turner, & Sons	Birmingham	Eye (hook and eye).
22	1592	Francis Mordan	6, Goswell-road	Adjusting everlasting gold pen.
,,	1593	Samuel Horwood Park,	Kingswood, Gloucestershire	Nut key or spanner.
25	1594	Thomas Hunt	Preston	Metallic packed gland.
26	1595	Frederick Marsh & Co.,	Castle-street East, Oxford-street	Oriental shower bath.
27	1596	Stephen Pelle Babington	George-street, Hanover-square,	Hat peg or support.

NOTICES TO CORRESPONDENTS.

Mr. Baddeley *must excuse us for declining to allow our pages to be longer occupied with the unsavoury dispute between him and Mr. Milne. In his anger at the uncourteous terms in which he has been spoken of, he seems wholly to forget that the dispute was one of his own free seeking, and that he it was who first set the example of indulging in personalities. We were wrong, perhaps, in allowing even so old and privileged a correspondent as Mr. Baddeley to express himself so harshly of Mr. Milne as he did; but having done so, we could not, in fairness, refuse to him who had been hit hard, the opportunity of hitting equally hard if he could in return. Although, however, we must put an end to the dispute between our two friends, we have too grateful a recollection of the services of one of them to this Journal to deny a corner to one paragraph in the last letter we have received from Mr. Baddeley, in which he thus replies to Mr. Milne's question, "Who is Mr. Baddeley?" "Permit him to say, he is a humble individual, who, from time to time during the past quarter of a century, has furnished the readers of the* Mechanics' Magazine *with frequent opportunities of forming some opinions of his 'natural sagacity and scientific attainments;' and whatever differences of opinion may prevail on these points, the integrity of his character, as a writer and a man, has never been called in question, and is altogether invulnerable."*

The "Reply" to Mr. Smith's "Vindication" is unavoidably postponed till next week.

CONTENTS OF THIS NUMBER.

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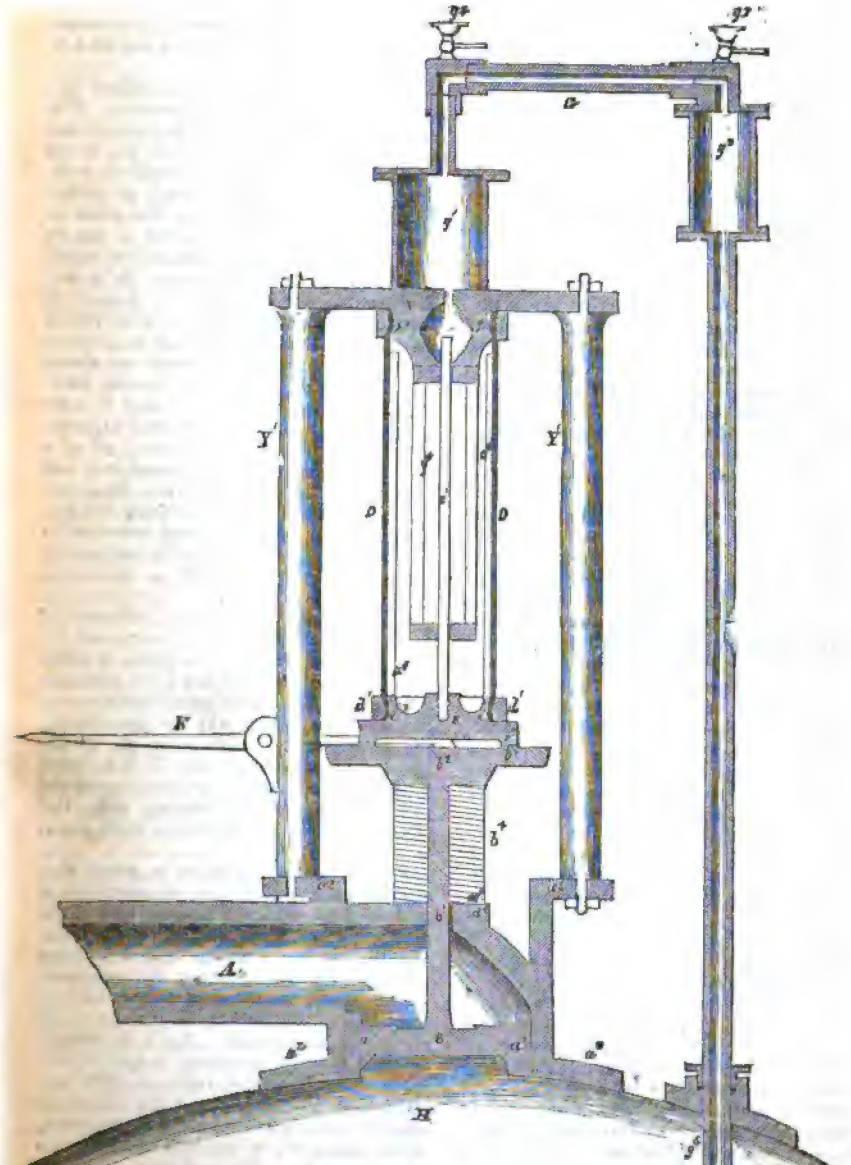
ALLIOTT'S PATENT APPARATUS FOR REGULATING THE WORKING OF STEAM BOILERS.



ALLIOTT'S PATENT APPARATUS FOR REGULATING THE WORKING OF STEAM BOILERS.

[Patent dated March 8, 1848. Patentee, Alexander Alliott, of Lenton Works, Nottingham. Specification enrolled September 8, 1848.]

The distinguishing feature of this invention, and no doubt it is a very valuable one, is, that it embraces in one apparatus a steam safety-valve, a vacuum-valve, and a valve which acts as a safety-valve when the water falls in the boiler below some fixed level. The prefixed figure represents a sectional elevation of the apparatus.

A is a steam outlet pipe which is attached by a flange, a^2a^2, to the top of the boiler, H; B is a valve with inward action, which fits a seating a^1a^1, formed for it on the inner surface of the mouth of the pipe, A. The spindle, b^1, of this valve passes upwards through an opening, a^4, in the top of the pipe, A, and terminates a little way above it in a circular plate, b^2, faced square with the valve, B. Round the spindle in the space between the top of the pipe, A, and the plate, b^2, there is coiled a spring, b^4, which rests on a flat boss, a^5, raised on the curved back of the pipe, A. D is an expanding tube made of vulcanized India-rubber and metal rings. I form this tube by encircling an India-rubber tube with rings of tinned copper placed at equal distances apart, drawing a second and the India-rubber tube over the rings, and fastening it to the inner tube, and then subjecting the whole to the well-known process of vulcanizing. The office of these rings is to support the tube against internal pressure, whilst, at the same time, they do not prevent its expansion lengthways. E is a circular plate, to which the tube, D, is attached at bottom; and Y another circular plateto which it is attached at top. The under plate, E, rests by an under projecting part, e^3, on a corresponding projection, b^3, raised on the top of the plate, b^2, of the valve spindle; and the upper plate, Y, is upheld by four studs, Y^1, which are supported by bearings, a^3a^3, raised on the back of the steam pipe, A. The tube is fastened to these plates by means of convex rings, d^1d^1, which take into concave seats, y^2e^2, formed for them on the upper face of E and under face of Y. Each of these rings is made in two parts and joined by flanges. The upper plate, Y, remains always fixed, but the under plate, E, is free to move when acted upon in the manner to be presently described. To preserve the parallelism of the plate, E, when so moving, it is provided with a guide-rod, e^1, which works through a guide frame, y^3, fastened to the upper plate, Y. A tube or ring, e^4, is laid loosely on the top of the concave seat, e^2, of the plate E, and inside of the tube D, but so as not in the least to restrain it in its movements.

The use of this pipe is to support the tube, D, in case of external pressure. F is a hand lever for depressing, and so opening the valve, B, when required. G is a series of copper pipes which communicate with the pipe D through an aperture in the centre of the pipe Y, and reach from that plate, as shown, to some determined level or line in the boiler, if the water sinks, below which it is time for the safety-valve, B, to act. The first pipe of the series, g^1, is made of the large dimensions shown, in order that it may contain cold water enough to prevent the intrusion of any warm water or steam into the tube D. The pipe, g^2, is also made of larger dimensions in order that it may, by the amount of surface which it exposes, prevent the formation of steam. g^3 is a tap for drawing off any air which may find its way into the series of pipes when the boiler has been at rest. By taking out this tap too, access may be obtained occasionally for cleansing the pipe G. g^4 is another tap through which the tube, D, is filled with water.

By calculating the internal diameter of the tube D, and making due allowance for its weight and the power requisite to make it expand, the result of any given pressure may be predicated with considerable exactness; but the easiest way for determining the size which the safety-valve, B, should bear to the expanding tube, D, is to cause this tube to be subjected to some ascertained pressure and then to calculate from the effects produced the size proper to be given to the valve B.

To elucidate the manner in which this apparatus operates, let it be supposed that it is desired to work the boiler, H, at some pressure below 8 lbs. on the square inch, and that when the steam becomes above 8 lbs. on the inch pressure, the apparatus should act so as to allow the steam to escape, and thus restore the pressure to its normal or safety point. Let it be further assumed that the combined weight of the valve, B, and of the tube, D, with the weight due to the height of the column of water is equal to 32 lbs., and that the power of the spring, b^4, to sustain B and D is also equal to 32 lbs. We may then obviously

throw out of calculation the weight of the apparatus altogether. Let us now suppose the valve, B, to have ten square inches of working surface, and the plate, E, attached to the expanding tube, D, to have sixteen square inches of effective working surface, and the lower end of the pipe, g^5, of the series of pipes, G, to be below the level of the water in the boiler; then, on sufficient pressure occurring in the boiler, the water will be forced up the long pipe, g^5, and as soon as the steam attains a pressure of 8 lbs. on the inch, there will be a pressure equal to 80 lbs. on the valve, B, to keep it in its place, while at the same time the pressure on the expanding tube, D, from the steam in the boiler, will be only 5 lbs. on the inch (3 lbs. on the inch being consumed in supporting the column of water in the series of pipes, G, from its level in the boiler to the highest point of the series, which is here supposed to be 6 feet high.) It follows that the pressure from the steam on the expanding apparatus will give 80 lbs. to push open the valve, B, and thus form a perfect equipoise. Should therefore any increase of pressure occur in the boiler (the weights and spring remaining the same) it will cause the valve, B, to open inwards, and thus allow the steam to escape, whereby the pressure will be again reduced to its normal point.

It will be obvious that this apparatus may be constructed so as to allow the steam to escape at any given pressure by suitably proportioning the valve B, the expanding apparatus D, and the spring b^4, to one another.

The way in which this apparatus acts as a safety-valve when the surface of water in the boiler sinks below the bottom of the pipe, g^5, is as follows: All the conditions of the boiler and valves being supposed to be the same as in the case last hereinbefore supposed (by way of exemplification) the pressure on the valve, B, will be 80 lbs. to keep it in its seat. Now, on the water in the boiler falling below the bottom of the pipe, g^5, the water contained in that pipe will of course run down into the boiler and its place be supplied by steam, when, instead of there being 5 lbs. on the inch pressure in the expanding apparatus, there will be 8 lbs., which will give 128 lbs. of pressure exerting itself to open the valve, B, against 80 lbs. exerted to support it in its place, a difference much more than sufficient to exclude all chance of danger.

It will be found on calculation that at any lower pressure of steam than has been just supposed, a proportionally similar effect will be produced whenever the level of water in the boiler falls below the bottom of the pipe, g^5, and will thus render it impossible to get any pressure of steam in the boiler until there is water enough in it to make such pressure perfectly safe. In case of a vacuum or partial vacuum occurring in the boiler, the valve, B, then acts so as to remedy it, for as the top plate, b^2, of the valve, B^1, presses only against the plate, E, of the expanding apparatus, D, it follows that any external pressure sufficient to overcome the force of the spring, b^4, will cause the valve, B, to open and thus prevent mischief (the protecting tube, e^4, preventing any collapse of the expanding tube D.)

Instead of the valve, B, opening inwards as before described, it might be made to open outwards by reversing the action of the expanding tube D, and altering the arrangement of the different parts accordingly; but in this case it will not act as a vacuum valve.

The inventor describes also three modifications of the preceding apparatus; by the first of which it is adapted to regulate the supply of water to the boiler, —by the second an alarum is sounded whenever the water in the boiler falls below some fixed point—and by the third the flue damper is worked.

GUTTA PERCHA ELECTRIC INSULATORS.—MR. REID'S PATENT.

Sir, — While your correspondents, Mr. Hammerton for himself, Mr. Baddeley for Mr. Bain, and "Z. U." for the Electric Telegraph Company, are severally claiming the merit of having been the first to appropriate gutta percha for the purpose of improving insulation in electric telegraphs, perhaps you will be kind enough to inform these gentlemen that in my patent of 1847, I claimed and patented two new forms of insulators of that material, one for a subterranean, and the other for a suspended telegraph. I have also in the same patent *disclaimed* the use of gutta percha as a covering for wire, either by wrapping or in tube, because of my having used it eighteen months previously, and because what has been once freely given to the public cannot be afterwards patented. I may also take the liberty of mentioning that I had some conversation with Mr. Hancock in 1845, on the subject of having some battery cells made from it. His Company were not in a position at that time to manufacture it, and so the subject dropped.

Yours truly,

W. REID.

THE "AMERICAN ELECTRO-MAGNETIC TELEGRAPH."—PROFESSOR MORSE'S CLAIMS.

The last number which we have received of the *Eureka* announces the re-issue to Professor Morse, *on the 15th of June*, 1848, of two patents for the United States, which he obtained some two or three years ago, but had surrendered for the purpose of amendment (the American Patent Laws allowing of this being done); but limits itself to giving a prefatory retrospect by the Professor, of the progress made in telegraphing by electricity down to the time when he directed his attention to the subject, and the "claims" to original discovery and invention with which his amended and reissued patents conclude. We have no intention of taking upon ourselves an investigation of the justice of these claims; but it is proper that we should note this fact for the information of the discerning reader, that Professor Morse had previously to these re-issues the advantage of seeing the specifications of all the other labourers in this department of applicate science, who have, since the date of his original patents, taken out patents either in America or Europe — including especially those of our countryman, Mr. Bain, who is obviously the party with whom the Professor is preparing himself for a fight—and of being therefore able *to shape his claims accordingly*. Of course this is a sort of advantage which cannot be denied by the American authorities to Mr. Bain in his turn, should he choose to avail himself of it; so that probably, by waiting a little while, we shall see what both parties themselves consider, on second thoughts, to be their respective rights. When the pleas on each side have been settled, it will be time enough for judge and jury to enter on their duties. We subjoin the "prefatory retrospect" and "claims" of Professor Morse:

Prefatory Retrospect.

"The original and final object of all telegraphing, is THE COMMUNICATION OF INTELLIGENCE AT A DISTANCE BY SIGNS OR SIGNALS.

"Various modes of telegraphing, or making signs or signals at a distance have been for ages in use. The signs employed, heretofore, have had one quality in common; they are *evanescent*, shown or heard a moment, and leaving no trace of their having existed. The various modes of indicating these *evanescent* signs, have been by—beacon-fires of different characters;—by flags;—by balls;—by reports of fire-arms;—by bells heard from a distant position;—by moveable arms from posts, &c.

"I do not, therefore, claim to be the inventor of telegraphs generally.

"The *electric* telegraph is a more recent kind of telegraph, proposed within the last century, but no practical plan was devised until about sixteen years ago. Its distinguishing feature is the employment of electricity, to effect the same general result of communicating intelligence at a distance, by signs or signals.

"The various modes of accomplishing this end by electricity, have been—the employment of common or machine electricity, as early as 1787, to show *an evanescent sign* by the *divergence of pith balls*.

"The employment of common or machine electricity, in 1794; to show *an evanescent sign* by the *electric spark*.

"The employment of voltaic electricity, in 1809, to show an *evanescent sign* by the *evolution of gas bubbles, decomposed from a solution in a vessel of transparent glass*.

"The employment of voltaic electricity in the production of temporary magnetism, in 1820, to show an *evanescent sign by deflecting a magnet* or *compass needle*.

"The result from all these electric telegraphs was the production of *evanescent signs* or *signals* only.

"I do not, therefore, claim to have first applied electricity to telegraphing, for the purpose of showing evanescent signs or signals.

"The original and final object of my telegraph, is to IMPRINT CHARACTERS AT ANY DISTANCE as signals for INTELLIGENCE; its object is to MARK OR IMPRESS THEM in a permanent manner."

The Claims.

To S. F. B. Morse, of Poughkeepsie, N. Y., for improvements in the mode of communicating information by Signals by the application of Electro-magnetism. Re-issued June 13, 1848.

"First: Having thus fully described my invention, I wish it to be understood that I do not claim the use of the galvanic current or currents of electricity for the purpose of telegraphic communications generally; but what I especially claim as my invention and improvement, is making use of the motive power of magnetism when developed by the action of the said current or currents, substantially as set forth in the foregoing description of the first principal part of my invention, as means of operating or giving

motion to machinery, which may be used to imprint signals upon paper or other suitable material, or to produce sounds in any desired manner for the purpose of telegraphic communication at any distances. The only ways in which the galvanic current had been proposed to be used prior to my invention and improvement, were by bubbles resulting from decomposition and the action or exercise of electrical power upon a magnetized bar or needle, and the bubbles and deflections of the needles thus produced were the subjects of inspection, and had no power or were not applied to record the communication. I therefore characterize my invention as the first recording or printing telegraph by means of electro-magnetism.

"There are various known modes of producing motions by electro-magnetism, but none of these had been applied prior to my invention and improvement, to actuate or give motion to printing or recording machinery, which is the chief point of my invention and improvement.

"Second: I also claim as my invention and improvement, the employment of the machinery called the register or recording instrument, composed of the train of clock wheels and other apparatus, or their equivalents, for moving the material upon which the characters are to be imprinted, and for imprinting said characters, substantially as set forth in the foregoing description of the second principal part of my invention.

"Third: I also claim as my invention and improvement, the combination of machinery herein described, consisting of the generator of electricity, the circuit of conductors, the contrivance for closing and breaking the circuit, the electro-magnet, the pen or contrivance for marking, and the machinery for sustaining and moving the paper, all together constituting one apparatus or telegraphic machine, which I denominate the 'American Electro-magnetic Telegraph.'

"Fourth: I also claim as my invention the combination of two or more galvanic or electric circuits with independent batteries, substantially by the means herein described, for the purpose of obviating the diminished force of electro-magnetism in long circuits, and enabling me to command sufficient power to put in motion registering or recording machinery at any distances.

"Fifth: I claim as my invention the system of signs, consisting of dots and spaces, and of dots, spaces and horizontal lines for numerals, letters, words or sentences, substantially as herein set forth and illustrated for telegraphic purposes.

"Sixth: I also claim as my invention the system of signs, consisting of dots and spaces, and of dots, spaces and horizontal lines, substantially as herein set forth and illustrated, in combination with machinery for recording them as signals for elegraphic purposes.

"Seventh: I also claim as my invention the types or their equivalent, and the type rule and port rule in combination with the signal lever or its equivalent, as herein described, for the purpose of closing and breaking the circuit of galvanic or electric conductors.

"Eighth: I do not propose to limit myself to the specific machinery or parts of machinery described in the foregoing specification and claims, the essence of my invention being the use of the motive power of the electric or galvanic current which I call electro-magnetism, however developed, for making or printing intelligible characters, signs or letters, at any distances; being a new application of that power, of which I claim to be the first inventor or discoverer.

To S. F. B. Morse, of Poughkeepsie, N. Y., for improvement in Electro-magnetic Telegraphs. Reissued June 13, 1848.

"First: What I claim as my invention, and desire to secure by Letters Patent, is the employment in a main telegraphic circuit of a device or contrivance called the receiving magnet, in combination with a short local independent circuit or circuits, each having a register magnet, or other magnetic contrivances for registering and sustaining such a relation to the register magnet or other magnetic contrivances for registering, and to the length of circuit of telegraphic line, as will enable me to obtain, with the aid of a main galvanic battery and circuit, and the intervention of a local battery and circuit, such motion or power for registering as could not be obtained otherwise, without the use of a much larger galvanic battery, if at all.

"Second: I also claim as my invention the combination of the apparatus called the self-stopping apparatus, connected with the clock-work of the register, for setting said register in action and stopping it with the pen lever (F), as herein described.

"Third: I also claim as my invention the combination of the point or points of the pen lever, or its equivalent with the grooved roller, or other equivalent device, over which the paper or other material, suitable for marking upon, may be made to pass, for the purpose of receiving the impression of the characters, by which means I am enabled to make or print signs or signals upon paper or other fabric by indentation, thus dispensing with the use of colouring matter for marking, as specified in my Letters Patent of January 15th, 1846."

THE EDDYSTONE LIGHT-HOUSE AND PLYMOUTH BREAKWATER.

Sir,—In the controversy respecting sea-walls, the Eddystone Light-house does not seem to have been instanced by the advocates of upright walls; yet that structure, an upright wall, affords an imposing example of stability; whereas, the Plymouth Breakwater evidences the injuries to which the long slope is liable.

These works may the more appropriately be brought into comparison, since it is the same storms to which both of them are exposed, the same destructive fury of heavy seas coming up from the Bay of Biscay and the South Atlantic Ocean: the long slope has been, from its commencement to the present time, more or less broken up on the recurrence of every severe storm; the Light-house has stood unscathed. I am, Sir, yours, M.

MR. HOLMES'S ALLEGED IMPROVEMENTS IN THE ELECTRIC TELEGRAPH.

Sir,—I have read, with much surprise, in the last Number of your Magazine, a letter from Mr. N. J. Holmes, of Hampstead, dated the 27th of September, in the latter part of which letter he says—"The construction of the telegraph is such as to leave the disc* independent and free from the magnet and helix, avoiding thereby the many interruptions from contact and other slight causes, and producing a signal more rapid and distinct than even my last improvement of the diamond telegraph," &c.

I am at a loss whether to ascribe Mr. Holmes's claim to this invention to a fervid imagination or to a treacherous memory; but if to the former, I am under the cruel necessity of demolishing the mirror in which he surveys himself as the inventor of the apparatus in question, by reminding him that, more than three months ago, and also on the 24th of July last, I asked him his opinion about a plan of mine for leaving the outside pointer "independent and free" from the inside deflector, so as to avoid "interruptions from contact, and other slight causes," and showed him a sketch of my apparatus. As Mr. Holmes takes so much interest in my inventions as to make them the children of his adoption, perhaps he can give me a clue to the friend in disguise who kindly called to see one of them that was out at nurse. I mean the gentleman who called on the 14th ultimo, at the house of a watchmaker at Kilburn, who is making a telegraph instrument for me, and professed himself very anxious to *learn something* about the electric telegraph instrument, but who afterwards confessed that he had more knowledge of it than he at first pretended to, and that he belonged to the Electric Telegraph Company. I am, &c.,

T. G. DE CHESNEL,
Electric Telegraph Co.'s Supt.,
London & North Western Branch.

Seymour-street Station, Oct. 4, 1848.

* The outside pointer.

EXTINCTION OF FIRES IN RAILWAY TRAINS.

Sir, — Should the following suggestion be of sufficient importance, I should feel obliged by the insertion of it in your Magazine.

Owing to accidents frequently occurring to goods sent per railway caused by sparks from the engine igniting straw or other combustible matter in the trucks, it has occurred to me that a small fire-engine might be of advantage in extinguishing such fires if fixed to the back end of the engine-tender, with a flexible hose sufficiently long to be either used for pumping the water from the tender or any convenient place near the line. It would also be of the greatest service should the engine run short of water before arriving at a regular engine tank. Yours, &c.,

E. ANDERSON.

Beal, Sept. 9, 1848.

SOME REMARKS ON THE "VINDICATION OF CERTAIN OBSERVATIONS ON SEA-WALLS" IN THE MECHANICS' MAGAZINE, VOL. XLIX., P. 282.

If the "Reply," &c., *Mech. Mag.*, vol. xlix, p. 234, had been intended solely for the perusal of the author of the papers entitled "The Sea-wall Question," &c., and its writer had been aware of the quantity of science possessed by that gentleman, it might have been charitable to have prefixed to it a short chapter on the resolution of forces; and now, entertaining much respect for the scientific attainments of the readers of this valuable periodical, he feels that some apology is due, for introducing in the present article, an investigation of the law according to which the horizontal pressure of a fluid is exercised on an inclined plane, considering that the process, which is to be found in every treatise on mechanics published from the age of Galileo to the present time, must be familiar to every one who has a claim to the title of engineer. In describing the process it is, however, intended to be as brief as possible; and the liberty is taken of referring to the diagram illustrative of the subject, which is given on p. 283 of this volume.

Let then q (represented by PQ in that

diagram) denote the pressure exercised in a horizontal direction by an indefinitely slender filament of the fluid terminating at P on the face of the wall, supposing that face to be in a vertical position or parallel to BC. Let ϕ denote the angle BAC, at which the face BA of the wall is inclined to the horizon; it will also denote the angle APQ or PQD, that is the inclination of BA or DQ (parallel to BA) to the line PQ. Then, by trigonometry, $q \sin \phi$ (=PD) is the pressure resolved perpendicular to BA; and, DE being drawn perpendicularly to PQ, $q \sin^2 \phi$ (=EP) is the effective horizontal pressure of the filament on the inclined plane BA.

Now, the number of filaments which act horizontally on BA, is evidently equal to the number which would act in the same direction on BC; if n represent that number, then nq would denote the horizontal pressure against an upright wall, BC, while $nq \sin^2 \phi$ represents the horizontal pressure against BA. The pressure that would take place against the upright front, BC, is therefore diminished by the construction of the inclined plane in the ratio of unity to $\sin^2 \phi$; and this is exactly in accordance with what is stated in the note appended to art. ii. of Sir Howard Douglas's "Protest."

The cause of Mr. Smith's misapprehension may be easily explained: He has confounded the pressure, p, of a particle or filament, with the number of horizontal filaments of the fluid which would act upon AB if it were in a vertical position, or rather, with the pressure which all those filaments would exert on AB in that position; in which case only is it true, that the quantity of fluid which "strikes" the plane is expressed by $p \sin \phi$. Thus Mr. Smith has it; and, after successive resolutions, it is evident that the horizontal force on the plane would vary with $\sin^3 \phi$. But of the difference between this mode of considering the pressures and that which has been employed in the "Protest," Mr. Smith has apparently no suspicion. The formula at which he has arrived would be applicable only in comparing the pressure against the face of an upright wall equal in height to the length of AB with the pressure against a sloping wall whose vertical height is BC only; as if an engineer were, for example, to compare the pressure upon a sea wall 50 feet high, vertically, and having a sloping face five times as long, with the pressure upon the upright face of a wall 250 feet high. Such a case was never contemplated by any person who had occasion to compare together the pressures of fluids against walls, when built in water of a given depth; the problem to be resolved is always a comparison of the horizontal pressures of a fluid against a vertical face and against an inclined plane, both having the same vertical height. It is, perhaps, unnecessary to remind the reader that, unless the last condition is assumed, a new element must be taken into account, which is the variation of the pressure of the fluid at different depths below the surface.

After what has been shown, it must be apparent that the author of the "Sea-wall Question," should have consulted some elementary work on mechanical and hydrostatical subjects before he ventured to assert that there is, in the note appended to Sir Howard Douglas's "Protest," a fundamental error in enunciation (*Mech. Mag.*, vol. xlix., p. 283); he might then, perchance, have discovered his own error, and a reference to the official copy of the Protest may show that Sir Howard committed no error in enunciation. The erroneous notation ($\sin \angle \theta^2$) is not in the Parliamentary copies of the "Report of the Harbour of Refuge Commission," where Mr. Smith will find $(\sin \theta)^2$ conformably to the Eulerian method. The form of notation so unmercifully criticised appears, as the critic of this paper now learns, in the *Mech. Mag.*, vol. xlviii., p. 564, and if the printer's devil had been referred to, it is highly probable that this functionary would have been sufficiently candid to acknowledge the existence of a typographical error in the place.* No uncommon circumstance in printing mathematical symbols, but from which this valuable miscellany is as free as any other work of the like nature.

The writer of the present paper would very much regret putting Mr. Smith's opinions in a shape to compel that gentleman to "repudiate the interpretation," could he perceive that he had actually misrepresented the expression of those opinions. He may have misunderstood the language; and this will not appear surprising to any one who has observed its looseness and inaccuracy.

* True.—P. D.

In the paper "On the Sea-wall Question" (p. 282), Sir Howard Douglas's "Protest" is stated to be "a continuous attempt to generalize the same doctrine," alluding to the fact that "materials of a certain class were washed up an incline of 18 degrees, while materials of the same class remained quiescent upon the lower plane of 11 degrees, and to the same level" (*sic.*) Passing by the absurdity of calling a fact a doctrine, there is not a syllable in the "Protest" about the washing of stones up inclined planes except where it is incidentally mentioned by the witnesses examined before the Commission; with what propriety, therefore, can it be said that there is an attempt to *generalize* such washings! Sir Howard Douglas's "Protest" appears to have been written for the purpose, certainly a very important one, of showing that the testimony of almost every great practical engineer, was unfavourable to the project of building a sea embankment with a vertical face. All experience, which should guide the engineer in forming such a work, is wanting; in the opinion of several eminent practical men, the attempt would be very likely to end in failure and the expenditure of several millions of public money be made in vain. The "Protest" cannot, therefore, with justice, be considered as "factious in its nature and unwarrantable in its object" (p. 284.)

Sir John Rennie, who mentions that stones of a certain size were washed up an inclined plane of 18 degrees, while the like materials remained quiescent on the plane inclined only 11 deg., is no doubt able to give a satisfactory reason for the fact; but Mr. Smith may rest assured that, neither the question which he has raised (vol. xlix., pp. 158, 282,) on this occasional sport of the waves, nor its solution, has anything to do with the relative merits of the upright and sloping faces of sea-walls. He may also be assured, that if "paving, casing, bonding," &c., &c., do not avail, for withstanding the shock of storms on a sea-wall with a slope, neither will "ashlar facings" serve to secure one which is upright.

Mr. Smith concludes his inconsistent paper with something like a threat, that if Sir Howard Douglas's "Protest," (which he qualifies with the character of an able document,) is to be placed in antagonism with his general views, it may be necessary for him to enter into its merits (p.284). It is but fair to ask who has undertaken to place the "Protest" in such antagonism? From his own lively imagination has he raised the phantom which he now appears disposed to combat. If by his *general views* are meant his question relating to the washing of stones up inclined planes, the "Protest," it may again be observed, contains nothing which can be made the ground of opposition to them.

The writer of this article is not disposed, and feels sure it would be highly displeasing to Sir Howard Douglas, to make any harsh rejoinder to what Mr. Smith has been pleased to assume, and accordingly to stigmatize; but, possibly, the intelligent and impartial readers who may have referred to the pages of the *Mechanics' Magazine* for instruction, information, or amusement, and who think that this able and widely-circulated Journal has been worthily opened to a calm and fair discussion of a much controverted question in physical science, and who may feel indebted to Sir Howard for having thus broadly brought it before the public—perhaps, those readers may have felt some surprise and regret that Mr. Smith, even if sound in his science, and right in his assumption, should have erred so grievously in his *bienséance;* and that whilst the charge, grounded upon mere assumption, of Sir Howard's inability to discriminate between right and wrong in algebraic notation, falls entirely to the ground by the fact that no such error was committed by him, Mr. Smith will not find it so easy to exculpate himself from the charge to which he has rendered himself obnoxious, of not exactly knowing how to discriminate between rudeness and bad taste, and that courtesy and amenity which it was his duty to himself, to Sir Howard, and to the high character of the respectable and impartial publication to which he appealed, most strictly to observe.

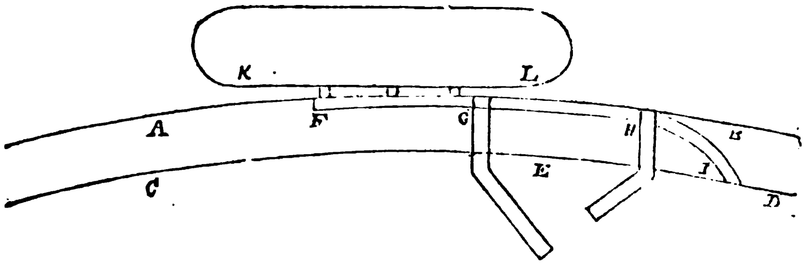
PLAN FOR THE IMPROVEMENT OF DOVER HARBOUR.

Sir,—Pending the discussion of the best form of sea-walls for the new harbour at Dover, I beg leave to offer a plan for improving the present harbour. The depth of water in the present harbour would have been amply sufficient to afford the requisite accommodation and shelter, if it had continued the same

as it was originally; but soon after its completion, the shingle entered the harbour, reduced its depth, and converted it into a mere tidal harbour.

The shingle moves along the south-east coast of England from west to east; when arrested by a pier, it accumulates till it reaches its extremity; after which it resumes its progress to the east, and in doing so fills up the harbour to the level of low-water, and throws a bar across its mouth.

By my plan all accumulation of shingle at the western side of the harbour is prevented. As soon as it arrives there, it is washed over, by the ordinary action of waves on shingle, into a canal, along which it is carried by a current of water, and finally deposited in the sea on the east side of the harbour, where it resumes its eastern progress without interfering in the slightest degree with the entrance to the harbour. The following sketch will explain the mode of operation.



A B is the line of high-water of spring tides; C D, that of low-water of neap tides; E, the harbour; F G H I, a canal lined with bricks; the seaward wall of the part F G is a foot or two lower than high-water level; the depth of that part may be 4 feet below the top of the seaward wall; the remaining part, G H I, of the canal leads round the back of the harbour to the shore on its eastern side as far as low-water mark of neap tides, the part, H I, being protected in the usual manner when drains are emptied into the sea at low-water mark. A reservoir, K L, must be excavated to a level with the bottom of the part F G of the canal, with which it must communicate by several inlets secured by sluices; there must also be a sluice on the principal canal at G.

The mode of operation is as follows: A little before high-water of spring tides, the water will begin to flow over the seaward wall of the head of the canal F G, carrying shingle along with it, especially when the waves are great; the sluice at G being shut, and those in the inlets to the reservoir being open, the water will flow into the reservoir, leaving the shingle in the bottom of the head of the canal. This operation will go on till some time after high-water; the reservoir will then be found filled with water, and a quantity of shingle deposited in F G; as soon as the sea has receded to low-water mark of neap tides, the sluice at G must be opened; then the water in the reservoir K L, flowing in by the inlets, will scour the head of the canal F G, free from shingle, which it will carry along the canal G H I, and throw upon the beach. This process must be continued every tide until the waters cease to rise as high as the top of the seaward wall of the head of the canal F G; by this means a large quantity of shingle will be shifted from the west to the east side of the harbour twice every month, all accumulation of shingle on the west side of the harbour will be prevented, and consequently the shingle will no longer pass round the extremity of the pier, enter the harbour and throw down a bar across its mouth. On the contrary, when the original depth of the harbour shall have been restored by dredging, it will be secured in all time to come, and its mouth no longer be impeded by a bar.

By this plan also, all the shore to the east of the harbour will be protected, by its natural covering of shingle, from denudation. Yours, &c.

ROBERT AYTOUN.

Edinburgh, September 25, 1848.

ON THE PRINCIPLES OF ALGEBRA, AS A SYSTEM OF GENERAL REASONING; WITH A SKETCH OF ITS RECENT PROGRESS, AND A REFERENCE TO SOME RECENT PAPERS IN THE "MECHANICS' MAGAZINE."

(Continued from page 820.)

It is a more difficult task to convey satisfactory views as to the utility of a *purely symbolical* algebra. In every *particular* algebra, the laws of combination of the symbols employed in it are *deduced* from the very nature of the operations which those symbols denote; and are, therefore, *necessary* laws, not *arbitrary rules*. For every different class of operations, a separate algebra may be constructed, having its own peculiar laws of combination deduced from the nature of that class which it embraces. The modern chemical notation is a particular algebra of this sort; it is *a* calculus of *a* particular class of operations. The laws of combination of its symbols are as different from those of arithmetical algebra as the significations of the symbols themselves. An unlimited variety of such *particular* algebras might be constructed, each having a different class of notions or significations to its symbols, and, consequently, different laws for their combination. It is worthy of remark here, however, that it is *possible* for some, at least, of the laws of combination to be *the same* in two or more of these different algebras; for though the significations of the symbols are different, it does not by any means follow as a necessary consequence that there may not be such a similarity in their natures as to render some of their laws of combination the same. For example, the symbol $\frac{d}{dx}$, or d_x, has a very different signification to that of any letter in arithmetical algebra, and yet some of the laws of its combination with symbols of its own class are precisely the same as those by which the letters of arithmetical algebra are combined.

Granting this, then, (the proof of which must, of course, be first seen in works on the differential calculus, before the student can fully comprehend how and why such is the case,) it is a necessary inference, that if in the one algebra, theorems are proved, the proof of which depends solely on *these laws of combination*, and *not* on the things or operations signified by the symbols, the theorems so proved are necessarily true in *the other* algebra in which these said particular laws of combination happen also to be true. For example; if the form of the binomial theorem is dependent solely on certain laws of combination of the letters used in it—albeit those laws were originally obtained purely on the supposition of those letters representing numbers; and if the symbols $\frac{d}{dx}$ and $\frac{d}{dy}$, or d_x and d_y do also combine according to these said laws, then is it absolutely necessary that the form of the binomial theorem remains unchanged when for the letters a and b there be substituted d_x and d_y. These latter symbols may, in addition, be subject to peculiar laws of combination of their own, different from those in arithmetical algebra. This obviously does not in the slightest way affect what has just been said. Or, on the other hand, the letters of arithmetical algebra may, on their part, be subject to a variety of other peculiar laws of combination of *their own*. So long as the theorem depends only on laws of combination which *are common to both*, so long must the theorem of necessity be true for both.

There will probably be little difficulty felt by any one, in thus conceiving the existence of different algebraic systems, each having its own symbols and laws of combination: in each of which the symbols have peculiar and known meanings, so that any symbolical expression in them can be translated into common language, and the whole processes in fact expressed in ordinary words, though perhaps not without much circumlocution; in each of which, moreover, there are theorems, the symbolical expression of which may remain the same after the significations of the symbols themselves are altered, and which indeed will necessarily remain so for two or more different algebraic systems, if the laws of combination used in the proof, happen to be common to these different systems. So that the same formula may express a proposition in arithmetic, or one in geometry, or one in chemistry, &c., &c., according to the meanings attached to the symbols.

Having thus seen different truths, in

totally distinct branches of science, expressed by one and the same symbolical formula, simply by attaching different meanings to the symbols, is it not a very natural suggestion to carry out this view and to inquire whether a formula which we have seen to express a proposition in arithmetic as well as one in geometry, for example, may not *also* express a truth in some *other* branch of science, (chemistry for example, (*when proper meanings are attached* to the symbols? What can be more natural under such circumstances and with such views as we have thus been led almost insensibly into,—what can be more natural than to ask whether we cannot *find out* such significations for the symbols occurring in any formula, as *shall make* that formula express a truth in some new branch of science? We have thus got to the notion of *interpreting old* formulæ, so as to make them express *new truths*.

Here then is a pleasant exercise for any one who chooses to amuse himself. Take a formula, to the symbols in which you attach no definite meaning whatever, and *by finding out* in some branch of science or other, proper significations, convert this dead and *purely symbolical* formula into the expression of a living truth, thus as it were, infusing soul into a skeleton. It will be understood, of course, from what has been said before, that in searching for such significations to the symbols, as shall thus convert the formula into the expression of a new proposition, we must constantly bear in mind, those laws of combination on which the formula was founded, and the new significations must be such as from *their very nature* to render these laws of combination, *necessary* laws. For example, suppose there is a theorem in arithmetical algebra which depends solely on the law of combination; $x^m x^n = x^{m+n}$ and we are endeavouring to find out in chemistry some operation, which when denoted by x, this theorem shall express a proposition in chemistry. In this case we must find some operation, which from its very nature is such, that if repeated n times, and then repeated m times on the result thus obtained, the *final* result is the same as if the operation (x) had been repeated without interruption ($m+n$) times. I give this, of course, merely as a rough illustration, without entering at all into the difficulties which may arise with respect to such applications in physical science. In this case, for example, the question of "time" enters as well as order of operation, and not having any counterpart in ordinary algebra, will most likely give rise to many embarrassing difficulties.

The comment which will naturally be made by most persons, when they have seized clearly the conception of a purely symbolical formula and the methods of interpreting it just set forth, is—what are the advantages of thus beginning with a formula of unmeaning symbols, and searching about for meanings that will suit? It certainly appears a very queer and preposterous way of proceeding, and one is very apt to call it reversing the *natural* order of things. If a person were disposed to be satirical, he might say that it was, for all the world, like searching for a man to fit a given coat, instead of making the coat to fit a given man, and is, therefore, an absurd kind of *Taylor's* theorem. He might say, too, that it had its failing cases, inasmuch as it is not always possible to find a man who will exactly *full-fill* the coat, or significations to fulfil the conditions of the theorem. He would not let slip either the opportunity afforded him by the phrase "Permanence of Equivalent Forms," as applied to one of the aforesaid symbolical formulæ or equations, and he would say that it was a very appropriate designation for such a standing or permanent coat, whereunto successive people were fitted, and not it to them, after the fashion of Procrustes' bed.

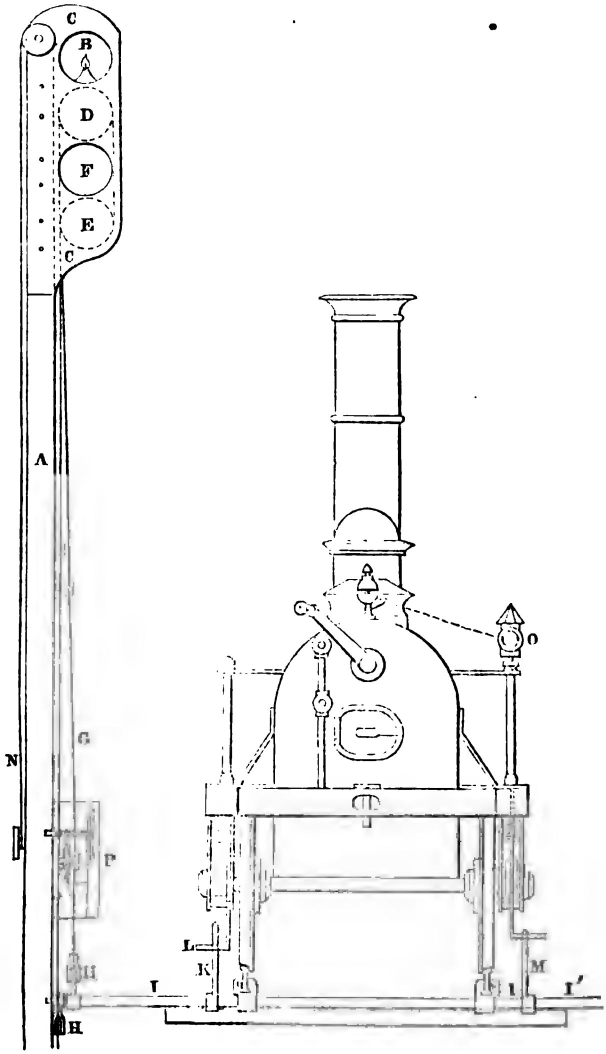
But, seriously, to reply to this comment is neither easy, nor in such a place as this advisable. It is no doubt true, that much time and ingenuity might, in fact, be misapplied in such a search for meanings to the symbols of a formula. As a matter of history, up to the present time, hardly any such search can be said to have been made; for whatever "extensions" have been made in the application of such formulæ, have arisen from known and familiar circumstances, and not sought out entirely *de novo*. And if, for the future, any such totally new modes of interpretation for the symbols of a formula are sought out, it will, no doubt, be from motives which, from their very nature, will not be understood until the application has actually been

made, and the new truth evolved from the old formula.

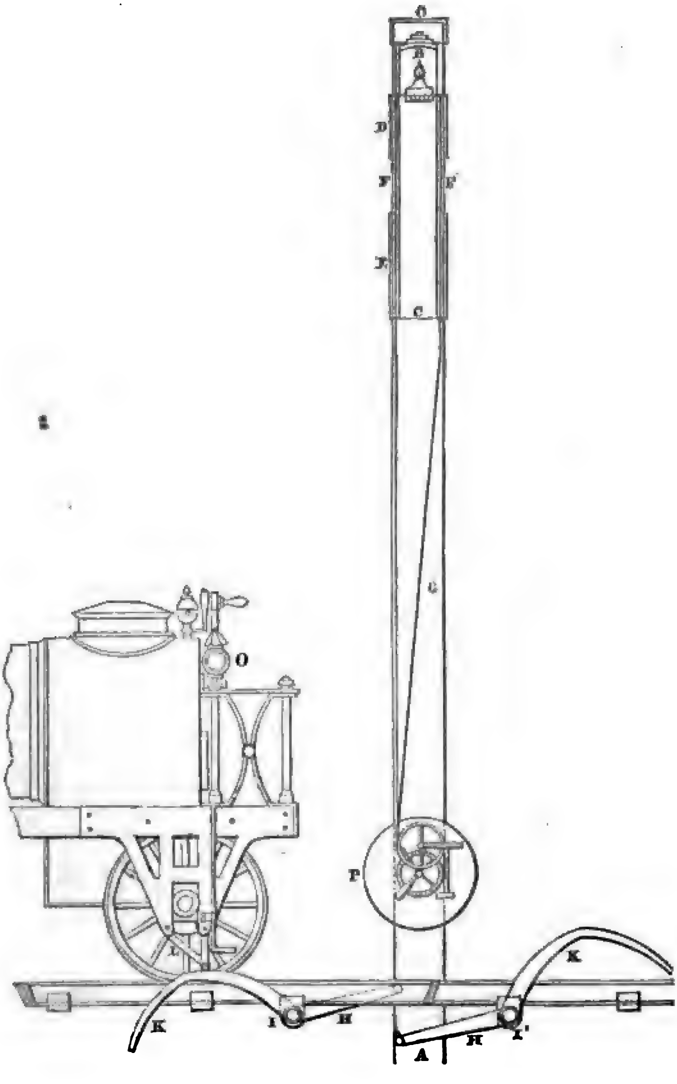
It may not be useless, perhaps, for the sake of some readers, to repeat here, that the mental process by which the interpretation of the symbols in any formula is extended, is the following:—(1st). A distinct perception of the conditions under which the formula has been obtained in the one science, arithmetical algebra, for example. (2nd.) An equally distinct perception of the existence of the same conditions or laws of combination in another science, geometry, for example. (3rd.) The necessary conclusion that, therefore, the formula expresses a truth in this other science, when the new significations are substituted for the old ones.

(*To be continued.*)

MESSRS. CUNNINGHAM AND CARTER'S PATENT RAILWAY SIGNAL APPARATUS.



The frequency of collisions on our railways, by which an enormous amount of property is often sacrificed, and the destruction of human life too frequently the result, almost invariably happens from a fast train running into a slower one, which has preceded it, or into vehicles left, for some cause or other, standing on the line. Now, with a self-acting arrangement, by which a signal would be exhibited at intervals (of say every mile), to inform the engine-driver of each train how far in advance the preceding train is, a step is obtained by which he would, according to circumstances, keep up his full speed, or so regulate it that he would never come into dangerous proximity with the foremost train. As he arrived at every mile signal, he would ascertain whether it was increasing or decreasing in rapidity of transit, as accurately as the driver in advance himself knows. Under such a system, it would be hardly possible for collisions to occur; and we are gratified to find that a simple, yet thoroughly perfected, plan of this description has been secured by Messrs. Cunningham and Carter, in their specifica-



tion for a new mode of propulsion on railways, and which is perfectly applicable to the locomotive, or any other system of railway transit.

In this plan, lamps are placed upon the line at intervals, exhibiting a white light when the road is clear; but, at the instant a train passes, a disc-plate, with a pane of red glass, is elevated, which, by covering the light, changes its colour to red. The disc-plate now slowly descends, and the time of its descent is susceptible of the nicest adjustment; the white light is again restored, which indicates that the road is clear for the following train. The mechanism by which this warning signal is worked is extremely simple. The train itself elevates the disc-plate, and the gravity of the plate and rod depresses it. The descending disc shows, by the proportion of red and white light, the interval of time since the last train passed, according to the time the machinery is regulated to. In case of accident or delay, the guard returns to the nearest lamp, perpetuates the red signal, and fixes a lever, which will act on the lamp and whistle of the coming train, and inform the driver that an *obstruction is not far distant.*

The accompanying engravings are representations of this time signal in different positions:—A is the lamp-post; B, the lamp, or night signal, showing a white light; C, lamp-case; D, disc of red glass, which rises on the passing of a train, showing a red light; E, red disc, to cover day signal; F, painted white; G, rods connected to disc-plates and time-levers; H, levers, fixed on ends of shafts, I and I′; I, shaft extending across the up line; I′, ditto down line; K, curved lever, on shafts, I and I′; L, tappet piece, on axle of engine, or tender; M, extra lever, for acting on engine-lamp and whistle; O, lamp on engine; P, time machinery.

The action is as follows:—On the axle-box of the engine, or tender, is fixed a projecting pin, as shown at L; as the carriages pass, this pin will press down the lever, H, fixed on the end of the connecting shaft, I, with the rod, G—disc-plates, D and E, thus signalising both night and day, and also the lever connected with the time wheels. It will thus be seen, on the next engine passing, the lever, K, will be depressed, raising the lever, H, with rods and disc-plates, and the lever of the time wheels, which, being acted upon by the rod and disc-plate, will regulate its descent to any time required.

Let us suppose the time wheels so regulated, that the discs require ten minutes for their full descent; the night signal being a circular disc of plain light, the covering disc a circular piece of red glass; and the day signal a circular disc of wood painted white, with the covering disc, one painted red; it is evident, in each case, the gradual descent of these outer discs will closely resemble an eclipse, and, from the position of the arc of the red circle upon the face of the white one, the engine-driver could tell, to the utmost accuracy, the distance of time the previously started train precedes his; or the white discs might be even graduated down the centre, and show the time exact—of course when the white signal is clear, he knows there is a clear field before him. This does appear to us to be the happiest idea of conveying warning in case of accidents which we remember to have seen, if not the *ne plus ultra* of railway signalising; the whole machinery is simple, and (with the exception of the levers) contained in the lamp-post and its pedestal; could hardly, by possibility, get out of repair, and can be erected at very inconsiderable cost.—*Mining Journal.*

A detailed account of the invention which forms the subject of the preceding extract from the *Mining Journal*, to the proprietor of which we are also indebted for the accompanying engravings, has already appeared in our pages, having been included in the very full extract which we gave of the specification of Messrs. Cunningham and Carter, immediately after its enrolment (see vol. xlvi., p. 416). We give this supplementary description, nevertheless, as it contains many additional particulars, and some very useful and necessary explanations. The invention seems to us to be well deserving of the praise bestowed upon it by our contemporary, and we trust that it will soon have a fair trial on some one of the leading lines.

NOTES ON THE EMPLOYMENT OF IRON IN THE CONSTRUCTION OF SHIPS. FROM THE UNPUBLISHED PAPERS OF THE LATE BRIGADIER-GENERAL SIR SAMUEL BENTHAM. WITH SOME EXPLANATORY ANNOTATIONS.

Introduction.

Notwithstanding the great amount of mechanical skill which has been exhibited in the construction of iron ships, it would seem that some of the late Sir Samuel Bentham's notes on the subject remaining amongst his papers may still be interesting and useful. These notes were made above forty years ago, the General having long entertained an opinion that metal might be largely employed in the construction of ships for the navy—for such parts, for example, as ribs and beams, even were wood to be continued for planking, as opinion might be against an entire metal structure. At length, in

the year 1810, timber for ship-building being at an enormously high price, and scarcely obtainable for any money, Sir Samuel determined to communicate officially his views on the subject of *metal ships*.

As the most probable means of effecting an innovation so great, Sir Samuel mentioned verbally his views to the Comptroller of the Navy; and, to diminish as much as possible objections likely to be started on the score of novelty, he informed him that a vessel navigable at sea had already been built entirely of copper, and boats for canals entirely of iron;—that he (Sir Samuel) had expected, the persons who thus first realized the idea, would have proposed metal ships to government, but that, as no further progress had been made in this direction, he requested the Comptroller to communicate to the First Lord of the Admiralty his (Sir Samuel's) views on the subject; begged that he would express his readiness to communicate on it with either or both of the surveyors of the navy, or with any other person his lordship might prefer. The Comptroller afterwards assured Sir Samuel that he had made the communication to his lordship, but did not give reason to believe that the proposal had as yet obtained a favourable reception. Upon this, Sir Samuel drew the attention of the Comptroller again to the subject, as also that of the surveyors, and exhibited to them drawings and descriptions of several modes of metal structure he had devised. The Navy Board, in consequence, authorized him to have models made to the extent of 100*l*. Various circumstances impeded for a time the construction of these models, until at length he had a modeller employed at his own house for the purpose, when this, like so many other of his improvements, was put an end to by the abolition of his office, and the introduction of iron ships was left to private enterprise.

Many years, however, seem to have elapsed before even private ship-builders substituted metal for wood to any extent; for even in the year 1828, Sir Samuel, in his "Naval Essay," in speaking of metals, could only say, "their use is now extending even to the composition of the shell of the vessel." The private mechanical skill which has since been exerted in the construction of iron ships, render most of Sir Samuel's notes on the subject no longer needful; but the following will, it is presumed, be found to possess novelty and value enough to justify their publication:—

Notes, &c.

[Against danger of foundering at sea, as also to give strength of structure, Sir Samuel had already introduced fixed bulkheads and water-tight compartments;* so now, in addition to this great improvement, he, for further security, and in the same view of affording strength of structure with the least weight of metal, devised a mode of construction which he thus noted:]

The sides of a ship, and the bulkheads themselves, should be composed of a kind of cisterns, of perhaps three feet fore and aft, by as much athwart ship, so as to admit of a man passing freely into them (or say but two feet). That is, the sides and bulkheads should be double, with space enough for a man to enter within them. All these cisterns would then be used for water, for dry provisions, or for other articles of store.† Thus all the space requisite for buoyancy would be added to the habitable part.

These cisterns themselves, if closed water-tight, might, in cases of emergency, be emptied of their contents, and thus give a very material additional amount of buoyancy to the vessel.

The specific gravity of materials being of much importance in ship-building, were metal employed in it to any great extent, various other considerations would be requisite besides those that are sufficient in regard to wood. In the case of metal, it would be necessary to consider well the several strains to which a vessel is liable, and to calculate as accurately as possible the different thicknesses of metal requisite at different parts to resist those various strains, so that there should be the least possible superfluity of a material of so great weight. In the case of the lighter material, wood, a little superfluity may well be admitted of as a precaution against the uncertainty of its texture.

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* See *Mech. Mag.*, vol. xliii., p. 188.

† An analogous mode of construction, with a view to strength, has just been introduced in the tubular iron bridge to cross the Menai Straits. To a limited extent it had been employed for wood by Sir Samuel in the instance of the water and powder tanks and cannisters in his experimental vessels in 1795. See *Mech. Mag.*, vol. xliii., p. 187.

The uniformity in the strength of metal in all directions, and its nowise varying by moisture or dryness, would obviate the weakness to which a structure of wood is liable by swelling and shrinkage, and, from the action of caulking; but the expansion and contraction of metals by heat and cold, would require to be well considered in the mode of structure of an iron vessel, so that variations of this nature should not tend to disunite component parts.

The rapid transmission of heat and cold by metals, is a circumstance advantageous in regard to the preservation at an equal temperature of articles kept below the water-line, whilst, where the rapid transmission of heat or cold might be injurious, the interior, as cabins, might be lined with non-conductors of heat.

The kinds of metal I should recommend would be different under different circumstances: as copper, mixed metals, wrought and cast iron, steel, according to the different parts in which they would be introduced.

The general rules under which I should recommend these metals to be introduced in the several parts of a ship would be cast iron, or mixed metal, where the strength of the part depends on its power of resisting compression, using cast iron, as being both the cheapest and the best adapted for this purpose, for all parts not liable to be wetted with salt water. For those parts the strength of which depends on their power of resisting tension, wrought iron, copper or steel, would be introduced. There seems little doubt but that for those parts where lightness might be a desirable property, steel might be employed at an expense little exceeding that of iron, considering that good steel has appeared by experiment to be about double the strength of good iron.

Where parts to be combined together are not previously ground, or otherwise made flat enough, for their surfaces to be brought into close contact throughout the juncture, the desired closeness might be effected by the interposition of a compressible substance, such as a soft metal, like lead; or of some more elastic matter as felt, or woollen cloth, with or without some unctuous matter. Such means would have the farther advantage of adding to strength by diminishing the transmission of vibration.

If iron be the metal, a cement of iron filings might in many parts be advantageous.

Metal pillars, whilst serving to support the decks and the bulkheads, and to connect them with the bottom, may, by being hollow, be made to serve the collateral purpose of a passage for air for ventilation.* Some of them for the extraction, or the admission of water.

The great quantity of iron now used in the form of ballast, and nowise contributing to strength of structure, should in all ships be made to form a part of the vessel itself so as to give it strength. The disposition of ballast influencing materially the sailing properties of a vessel, its situation should be determined on the design of a ship; consequently, there could be no inconvenience in making it from the first a fixture; that is, so much of it, as exclusively of guns, provisions, water, &c., might be requisite to give stability* to a loaded vessel.

Were chain cables to be used,† they

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* Sir Samuel in his Minute at the Navy Board, 8th August, 1811, spoke of "the great importance to the preservation of ships themselves, as well as to the health of seamen, that means should be provided for the due ventilation of ships throughout"—referred to Dr. Hales's work on that subject, and to a letter of his (Sir Samuel's) to the Secretary of the Admiralty, 15th January, 1805—and gave his opinion that Dr. Hales's ventilator, then still used in the navy under the name of "White's Extractors," was efficacious for the extraction of foul air, but that "no contrivance had hitherto been introduced adequate to the easy and regular admission of *fresh* air to supply the place of that which had been extracted, so that in some cases while foul air has been extracted from one part of a ship, still worse has been drawn in from other parts."

Sir Samuel then observed, "As to the apparatus requisite for the due ventilation of ships, in the construction of new ones, or when the repairs to be given to others admit of it, it seems desirable that two sets of pipes, or trunks, should be laid throughout, having apertures opening into every close compartment; one of these sets of pipes, being those subservient to extraction of foul air, to lead to a fixed ventilator, placed at that end of the ship where room for it can best be spared; the main pipe of the other set of pipes for the conveying fresh air into the several compartments, to be brought up on the quarter deck or forecastle, where most out of the way, and clear of foul air."

† The influence which the position of ballast has on the sailing properties of a vessel was manifested in the case of one of Sir Samuel's experimental schooners. She had been remarkable for speed and as a good sea-boat, till on the change of her commander, the new one, after his first cruise, came into port complaining of her inferiority to other vessels in those respects. It was found that the ballast, which had before been disposed at the bottom of the schooner, he had caused to be winged up seven pigs high at the sides. The ballast was replaced as it had been at first, and the schooner from that time resumed her good properties.

† The advantages which would result from the introduction of iron chains in lieu of hempen

should be wound on rollers placed as low as possible in the ship to serve as ballast whilst the ship is under sail; while at anchor the omission of this weight would be rather advantageous than otherwise.

The effect of shot upon metal is a point which would require experiments, in order to ascertain the difference that would result in consequence of the non-elasticity of metal when struck by a shot; particularly in regard to the size and shape of the aperture made, to what extent beyond it the metal would be likely to be torn, the kind of splinters that would be carried within board, &c. Such experiments would be easily made by firing shot of different sizes, and with different velocities, against plates, of metal of different kinds and different thicknesses; which plates, however, should be affixed to a body floating upon water, in order that they might have the same advantages of that slight recoil on the water, which would exist in regard to metals employed in vessels for sea service.

Sir Samuel also proposed experiments on the effects of iron on the compass, and that they should be made on board a sheerhulk then about to be built for the use of Chatham Dock-yard, which vessel he wished to be the first of iron, and to serve—as she would be under the constant inspection of dock-yard officers—as a suitable ship for making regular observations on the several points which it might be useful to notice in respect to the strength, durability, and other circumstances relative to the substitution of metal for wood in naval architecture.

The time has long passed when first experiments were needful in regard to metal structure; but the principle inculcated in proposing it, in the first instance, for a vessel where no danger and little percuniary loss would result in case of failure, is a principle which should be uniformly kept in view in the first introduction of all doubtful innovation. But that Sir Samuel himself entertained no doubt of the efficiency of metal structure is evident from his Statement of Services, where he says (p. 172), "The introduction of different metals as a substitute for timber, conformably to ideas of mine already communicated to the Board, I will venture to assert will be found productive of the most important improvements that have been hitherto suggested in naval architecture."

It would seem that the experiments he suggested as to the effect of shot on metals, are now alone wanting, in order to ascertain the advantages of metal structures for ships of war, as well as for those for commerce. In the Report from the Select Committee on Finance, ordered by the House of Commons to be printed 28th July last, the Report (p. 66) states that "contradictory evidence has been given as to the applicability of iron to the construction of war steamers," &c.; and (p. 103) it appears in regard to that paragraph, that an amendment of it had been proposed in the Committee as follows: "The evidence of the only officers examined by your Committee, who have commanded iron steam vessels under fire, is unanimously in favour of their fitness for war; and the result of the experience of these officers was communicated to the late Board of Admiralty previously to iron steam vessels having been ordered for purposes of war. On the other hand, an experiment at Portsmouth was unfavourable. This experiment, however, appears to have been entirely insufficient on account of the weak and decayed state of the hull on which it was tried. Your Committee cannot offer any satisfactory opinion on this subject, but they recommend that no further expenditure shall be incurred on steamers of war until the question shall be conclusively set at rest by further experience and experiment." This amendment was, it is true, negatived; but the circumstance of its proposal having been stated to the House, is proof of the doubts entertained by the Committee, as to the objections that have been made to the use of iron for vessels of war, and of the need, in their opinion, of adequate experiments on the subject, such as those indicated by Sir Samuel Bentham eight-and-thirty years ago.

But experiments of the efficiency of iron structure against shot is not confined in their importance to vessels of war, since those for commerce, armed as

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cables, as also of iron for standing rigging, had many years before been suggested to him by Mr. John Peak, and had been frequently spoken of by Sir Samuel at the Navy Board. For the reasons why he did not urge the introduction of this improvement see his "Statement of Services," page 169.

many of them are, would, notwithstanding, of necessity strike on the first hostile attack, should their sides be incapable of resisting shot.

In the Report of the same Committee (p. 63) will be found, "It has been stated by the Storekeeper-General that the supply of British oak, even at a monopoly price, is failing." In case, therefore, that the result of experiments should afford conviction of the unfitness of a structure entirely of metal, Sir Samuel's proposal of introducing that material, as above mentioned, for such parts as ribs and beams, cannot but be regarded as a great improvement. His drawings of the application of metal for these and other parts were left at the Navy-office when he quitted it in 1812.

ROBERT MURPHY, THE MATHEMATICIAN.

Sir,—In p. 297, is an inquiry respecting the last days of Robert Murphy, ending thus—"Murphy's death was, I believe, attended with melancholy circumstances." Your readers will find what I believe is the only account of Murphy, in the proper alphabetical place of the Supplement to the *Penny Cyclopædia*. With respect to his last days, it is within my knowledge (authenticated by the private transmission of my name) that the last years of his life were rendered more comfortable than those previous to them had been by his situation as Examiner to the London University. The last time I saw him, he spoke with more cheerfulness on his prospects than he had ever done since I knew him.

But the main purpose of this letter is to prevent Robert Murphy from being placed among the list of ill-used benefactors of mankind. His scientific merit was allowed to mitigate the consequences of *his own misconduct*. That misconduct was not without its own means of averting a very harsh judgment; for, as is remarked in the article above cited, "There is much excuse for a very young man, brought up in penury, and pushed by the force of early talent into a situation in which ample command of money is accompanied by even more than proportionate exposure to temptation." But we must be just, even to society at large; and, above all, we must prevent the list of those to whom the world has been ungrateful from containing men who have originated their own sufferings. Now, in the case of Murphy, it must be remembered that, after leaving Cambridge, with his fellowship under sequestration, for debts incurred in a course of dissipation, which was a very bad example for the young men whom he had to teach, he found friends and resources where a man of ordinary intellect would have sunk into beggary. He found assignees who treated him with consideration, and friends who procured him pupils and occupation in writing (to which we owe his work on the theory of equations). His college had apprized him that his election to one of the more valuable fellowships would take place; and the Senate of the University of London, with full knowledge of his preceding life (and of his amendment also,) elected him an examiner. Had he been a man of commerce instead of science, he would have been irretrievably ruined, in all probability; as it was, had he lived, he would have worked out of debt, and re-established himself at Cambridge, where I have good reason to know he would have been received as a new man, with everything in oblivion except his scientific merits.

There is a lesson in Murphy's story which may be of use to some of your readers. The *Mechanics' Magazine* must fall into the hands of young men who are destined to rise by pure force of talent, and to live by their heads in later, as by their hands in earlier life. That lesson is—*take care to provide mental relaxation as well as mental occupation;* for relaxation there must be; and a majority of those who attain power of mental exertion, and have only the relaxations of conviviality, fall into habits of excess. This is one of the interpretations of an aphorism uttered by a man of note in a communication between certain Cambridge men, which had Murphy's restoration for its object:—*He is a man whose special education is in advance of his general; and such subjects are almost always difficult to manage.*

I am, Sir, yours, &c.,

Y. K. W.

October 2, 1848.

We append the biographical notice of Murphy given in the *Penny Cyclopædia;* it is exceedingly interesting, and coupled with the judicious comments of our correspondent no less instructive. Ed. M. M.

Robert Murphy was the third of the seven children of a shoemaker, parish clerk of Mallow in Ireland: he was born in 1806. His father intended to have brought him up to his own trade; but the son's destination was changed by an accident which nearly cost him his life. When eleven years of age, while playing in the streets of his native town, he was run over by a cart, and lay on his bed for twelve months with a fractured thigh-bone. During this confinement, his family supplied him with such books and newspapers as they could procure; and among them there happened to be a Cork almanac, containing some mathematical problems. These attracted the child's attention, and made him desirous of possessing Euclid and a work on algebra. The books were procured with some difficulty, and before he was again able to walk, and before he was thirteen years of age, young Murphy was an extraordinary instance of a self-taught mathematician. A gentleman of the name of Mulcahy, of Cork, who was the tutor of most of those from the South of Ireland who got fellowships at Dublin College, was in the habit of proposing problems (or *cuts*, as they are called in Cork) in the newspapers. At a certain time he began to receive answers by return of post, from Mallow, without any signature. Surprised at the extraordinary talent displayed in these answers, Mr. Mulcahy went to Mallow to find out his unknown correspondent. After some difficulty, he found that the asserted author of the answers was a boy on crutches, so young that he could not believe the story. A few minutes' conversation, however, put it beyond doubt. On coming away, in amazement, he happened to meet the gentleman to whom we are indebted for this account, to whom he said, with natural exaggeration, "Mr. Croker, you have a second Sir Isaac Newton in Mallow: pray look after him." It was then agreed that the boy should give up learning his father's trade, and pursue his studies. Mr. Hopley, who kept a classical school in Mallow, had the generosity to take him as a pupil without any charge: and he, in after life, had the satisfaction of transmitting to the widow of his teacher, then reduced to poverty, the sum which an ordinary pupil would have paid.

When he attained the age of seventeen, great exertions were made to get him entered as a student of Trinity College, Dublin, but without success. The examinations for sizarships being classical, he had no chance: and some mathematical papers—which were sent to the authorities as the productions of a boy who had never had a teacher, and which, to judge by what we shall presently see, must have been of no common merit—received no attention. At this time, Mr. Mackey, a Roman Catholic priest, published a duplication of the cube, the plausibility of which attracted attention, and, it is said, even obtained the assent of the teachers at Maynooth. Young Murphy, then eighteen years of age, answered this duplication in a pamphlet, entitled "Refutation of a pamphlet written by the Rev. John Mackey, R. C. P., entitled 'A method of making a cube double of a cube, founded on the principle of elementary geometry,' wherein his principles are proved erroneous, and the required solution not yet obtained; by Robert Murphy, Mallow, 1824," (20 pp.) The matter and style of this production are really extraordinary under the circumstances: with the exception of a little too much acerbity of expression, and a mere slip in a point of history, a critic would not find anything to attack in it, even as the work of an educated person of mature age. The young author had a confusion in his head between Lord Brounker and Dr. Brinkley, when he says that "Dr. Brounkley" had expressed the circumference of a circle by a continued fraction.

The gentleman to whom we have several times referred now determined to try to get young Murphy sent to Cambridge. He applied to the clergyman who presented the boy with his Euclid and algebra, Mr. Brown, who was then employed in a parish of which Mr. M'Carthy, a Cambridge Master of Arts, was the proprietor. This last-named gentleman, being then about to visit England, promised to take some of Murphy's papers with him, and to do what he could to induce his old tutor, Professor Woodhouse, to interest himself in the matter. The first answer was not very encouraging. Mr. Woodhouse would say no more than that if they would send the boy, he would look after him. On being requested to look over the papers, he declined, saying, that he had no time, and made it a rule not to do so. He desired that the papers might be taken away; and on being requested to allow them to remain, to meet the case of his possibly being able to look at them, he predicted for them the fate of waste paper, and the interview ended. In six weeks from that time, however, Mr. Woodhouse wrote a hurried letter to Mr. M'Carthy, stating that at the moment when he was about to tear the papers, in fulfilment of his prophecy, his attention was struck by something that was almost new to him—that, on turning page after page, he saw with delight so much talent that he was really unable to say how long he remained fixed to the subject that he intended should occupy him but a moment—that suddenly, recollecting it was the last

day for entrance, he hastily went and placed the name of the writer on the boards of Caius College. He concluded by promising that if his friends would send him with fifty or sixty pounds in his pocket, he would take care that they should not be called on again: and this promise was faithfully kept. Mr. Croker immediately obtained about seventy pounds by subscription, and Mr. Murphy began his residence at Caius College in October, 1825. During his residence, the college supplied him with money, in addition to the proceeds of his scholarship. In 1829 he took the degree of bachelor of arts, and came out third wrangler. The highest place is sometimes not to be gained by any amount of genius and industry, unaccompanied by strict attention to the university course of reading: and Mr. Murphy's time was much occupied by speculations of his own, which would not turn to much account in an examination. In May, 1829, he was elected Fellow of Caius; he shortly afterwards took deacon's orders (he did not proceed farther), and was made dean of his college (the dean is, at Caius, an officer who, under the master, regulates the chapel discipline) in October, 1831.

Of what he did in mathematics we shall presently speak: we could wish there were nothing more to say of his private life. He gradually fell into dissipated habits, and in December, 1832, left Cambridge, with his fellowship under sequestration for the benefit of his creditors. There is much excuse for a very young man, brought up in penury, and pushed by the force of early talent into a situation in which ample command of money is accompanied by even more than proportionate exposure to temptation. His college admitted the excuse to its fullest extent: and though it could not tolerate the continued residence of an officer who had shown such an example, yet it was understood that his ultimate promotion to one of the more valuable fellowships would take place on the amendment of his excesses. After living some time among his friends in Ireland, he came to London in 1836, to begin life again as a teacher and writer. Among other things, he obtained from the Useful Knowledge Society an engagement to write the work on the Theory of Equations presently mentioned. In October, 1838, he obtained a small permanent income by his election to the examinership in Mathematics and Natural Philosophy in the University of London; but, burdened as he was with debt, this was rather an addition to the instalments of his creditors than an increase of his own means of comfort. He submitted with resignation to the effects of his own misconduct, and showed himself most willing to make every exertion, though well knowing that many years must elapse before he could, by any effort, redeem the ground he had lost. He died March 12, 1843, of a disease of the lungs.

Mr. Murphy's writings were as follows: —*Cambridge Philosophical Transactions:* vol. iii. part 3, General Properties of Definite Integrals; vol. iv. part 1, On the Resolution of Algebraic Equations; part 3, On the Inverse Method of Definite Integrals, with Physical Applications; vol. v. part 1, On Elimination between an Indefinite Number of Unknown Quantities; part 2, second memoir on the Inverse Method of Definite Integrals; part 3, Third Memoir on the same; vol. vi. part 1, On the Resolution of Equations in Finite Differences. *Philosophical Transactions:*—1837, part 1, Analysis of the Roots of Equations; part 2, First Memoir on the Theory of Analytical Operations. *Separate Works:*—Elementary Principles of the Theories of Electricity, Heat, and Molecular Actions, part 1, On Electricity, Cambridge, 1833, 8vo.; A Treatise on the Theory of Algebraical Equations, London, 1839, 8vo. (Library of Useful Knowledge): to these must be added some brief communications to the *Philosophical Magazine*, and various articles on subjects of Physics in the *Penny Cyclopædia*, beginning with the letter D.

Mr. Murphy's character as a mathematician is too well known to require any comment of ours; while the facts of his life, and in particular those of his removal to Cambridge, have not been recorded: we have, therefore, preferred to devote our space to the insertion of the latter. What he might have been if the promise of his boyhood had not been destroyed by the unfortunate circumstances we have described, it is difficult to say; for he had a true genius for mathematical invention. Before, however, he had more than commenced his career, his departure from Cambridge, and the necessity of struggling for a livelihood, made it impossible for him to give his undivided attention to researches which, above all others, demand both peace of mind and undisturbed leisure.

FOOT-SUSPENSION BRIDGE, SUN TAVERN FIELDS, SHADWELL.

A foot-suspension bridge has just been erected under the direction of our esteemed contributor, Mr. William Dredge, C.E., across the Ropery-grounds in the Sun Tavern Fields, parish of Shadwell, to form a communication between the Commercial Road and the London Docks. The bridge is built of iron, with the exception of the

roadway, which is planked with 2½ inch yellow battens. The clear span of the bridge is 91 feet, the width of the roadway 7 feet 6 inches. Each chain as it rests upon the tower of support is composed of eight five-eighths of an inch round bar of iron, and four bars, each half-inch in diameter; this gives an aggregate section at each end of 6·52 square inches of iron in the chains, the breaking strain of which is 195 tons, being equivalent to 132 tons placed upon the platform. The weight however, which the bridge will bear in safety is only one-third of this, or 44 tons. The holdfasts, to the retaining chains, are held in their places by being securely imbedded, each in about 10 tons of concrete. The platform, when extremely loaded will hold about 150 persons. Estimating each person at 168 lbs. the total weight will be 11·75 tons, to which, adding 10 tons as the weight of the bridge, we get 21·75 tons as the extreme load which the chains will ever have to resist; but as they are capable without injury of bearing 44 tons, there is a surplus power of 21·25 tons over and above the greatest load of persons.

EX-REVIEWER AT FAULT AT LAST!

Eureka! I have long looked out for your reviewer (and now "Ex-Reviewer") giving *proof* of his ignorance and incapacity; and I have found it at last! What kind of an algebraist must he be who cannot divide 1 by $1+x^2$ without blundering? A pretty critic, indeed, upon other men's labours! He ought to be sent to school and well whipped.

Your "Ex-Reviewer" has handled me roughly—why should I show more mercy to him? I have given him rope—and he has done as usual in such cases. I shall content myself *at present* with pointing out the blunders and their corrections. (See p. 328, col. 1.)

For $1-x+x^2-x^3+\dots$

read $1-x^2+x^4-x^6+\dots$

For $1-\frac{x^2}{2}+\frac{x^3}{3}-\frac{x^4}{4}+\dots$

read $1-\frac{x^3}{3}+\frac{x^5}{5}-\frac{x^7}{7}+\dots$

For $\tan y-\frac{\tan^2 y}{2}+\frac{\tan^3 y}{3}-\dots$

read $\tan y-\frac{\tan^3 y}{3}+\frac{\tan^5 y}{5}-\dots$

I am, Sir, yours, &c.,

VIRUS.

October 2, 1848.

[Our correspondent seems to be "terribly in earnest;" and he is rewarded, as usual, by the discovery of one of those interesting productions of nature—a mare's nest. Most mathematicians would have found in the case a mere *lapsus pennæ*. The "Ex-Reviewer" himself had, however, pointed out the error for correction; but we have printed "Virus" to show our readers the kind of criticism with which we are often doomed to be overwhelmed. We have only to ask "Virus" whether one single *principle* or *argument* of "Ex-Reviewer" is affected by his correction? At the same time the correction ought to be made; and, for once, we have gone out of our way and given the letter of "Virus" entire rather than the simple indication of "Ex-Reviewer."—ED. M. M.]

THE "VLADIMIR" RUSSIAN STEAM FRIGATE.

The *Vladimir* is the name of a new steam frigate which has just been built and engine-fitted in the Thames, for the Emperor of Russia, and which, after making several successful trial trips to the Nore and back, is now at Plymouth, preparing for a voyage to Sebastopol, in the Black Sea. The vessel is stated to be of 1200 tons burden, with 14 feet draught of water on an even keel. The total weight of the steam machinery (with a supply of water and fuel included), is about 220 tons, and the space occupied by the engines and boilers, 60 feet high by 20 feet in breadth. The engines, which are on the oscillating principle, and fixed horizontally, are nominally of 400 horse-power; but the actual power, as shown by the indicator-card, is 1200, so that the weight of the machinery does not much exceed three cwt. per horse-power. The cylinders are 78¾ inches in diameter, with a six feet stroke; and the wheels which they have to drive are 25 feet 4 inches in diameter, with 4 feet 9 inches immersion. On one of the recent trial trips, with a pressure of steam in the boilers of 12 lbs. per square inch, the paddle-wheels made 19 revolutions per minute; and the average speed on the measured mile at Long Reach, was 11 knots per hour. The boilers, which are four in number, are placed—two aft of the engines and two abaft of them, and there is a passage between each pair into the engine-room in the centre. The furnaces under the boilers are worked from the back; and to prevent the radiation of the heat from the front of the boilers, they are screened on that side by partitions of wood. The whole height of the boilers is only 8 feet 6 inches, which is 1 foot 6 inches below the load water-line. The air-pumps are worked by vibrating trunks, without guides. Two valves or slides are attached to each engine and wheel, and act as counterbalances. They are worked by four connecting-rods, which, again, are worked by four eccentrics, fixed on the crank-shaft by an arrangement similar to that used in locomotive engines—a plan first introduced by Messrs. Rennie in marine engines. The starting, stopping, and reversing gear—the barometers and steam-gauges—are all conveniently placed within

reach or under the eye of the engineer. The boilers are supplied, when not working, by a small steam or donkey engine, which is worked by the waste steam from the boilers.

The performances of this vessel on the trial trips in the river, were in the highest degree satisfactory, and such as to do great credit both to the builder (Mr. Mare), and to the engineers (Messrs. George and John Rennie). So exactly had the effects of the different weights to be placed on board of her been allowed for, that no material difference could be detected between her calculated and actual displacement. And the machinery, too, was in every part so perfectly adapted to its intended uses as to need no alteration or re-adjustment whatever after being put on board. The striking contrast in these respects which the *Vladimir* offers to some of the steamers recently constructed for our own Government, under the superintendence of Government officers, has been thus forcibly adverted to in the *Times*, in a leading article on the Navy Estimates, in which it contends for the propriety of handing all the Government work over to private contractors:

"Can such a steamer as is required for the Royal Navy not be built on the system adopted in private yards? The Russian Government clearly thinks so, for the *Vladimir* has just been launched at Blackwall; and we hope our readers did not overlook that she sat the water like a duck at the very first plunge, that her engines did not require to be displaced, her boilers to be strengthened, her bunkers to be removed, her stern to be altered, her paddle-floats to be changed, her valves to be tested, or her beams to be renewed, but that she slid off the stocks exactly what she was intended to be, and was sent off to her work at once. We shall be curious to hear what she costs in "repairs" and "improvements," and how many days' service are thus lost by her in the course of the next two years. We humbly think, that as far as experiments can teach anything, it has been fully proved that nothing is secured by the expensive system of our dockyards which may not be readily guaranteed under a system costing not two-thirds of the money."

P. S. Since writing the preceding we learn from a correspondent at Plymouth, that this vessel made the voyage round from the Nore to the Isle of Wight at the rate of 11¾ knots per hour, having performed the entire distance (154 miles) in thirteen hours.

THE PLANET NEPTUNE.

Sir, — Having read the article headed "*The Planet Neptune.—An Astronomical Mistake*," published in the last part of your valuable Magazine, I intended to send you some extracts from Leverrier's paper contained in the *Comptes Rendus* for the 11th of September; but I find the *Athenæum* has published a translation of the article; and I am quite sure your proverbial love of fair play will induce you to reprint it, so that your readers may learn what Leverrier really has to say upon the matter.*

The scientific dodgers, in this country, first propagated a story that the planet Neptune is no planet; the same chivalrous set, in their praiseworthy vocation, have recently changed their tactics—and the current fib for some weeks has been that the planet Neptune is not Neptune, but another planet. Some account of these dodges may amuse your readers. I intend to send it to you shortly. In the mean time, you and other real friends of British science will be pleased to find that the planet Neptune, the position of which was undoubtedly fixed by our countryman, Mr. Adams, and communicated by him to the Astronomer Royal and to Professor Challis, *eight or nine months* BEFORE Leverrier had written a word upon the subject, has, for some time past, been favourably situated for observation, and *has been actually observed every clear night at the Cambridge Observatory.* Its place for G. mean midnight, on the 20th ult., was

R. A. 22h „ 11m „ 9s·94
N. P. D. 101° „ 56′ „ 3″·3.

It is impossible to say what deceptive inuendo an active and unrestrained invention may next set agoing; but, be this as it may Mr. Adams' claims to the priority of the magnificent discovery of the new planet are indisputable; moreover, in the very teeth of detractors' fictions, the new planet may still be seen moving in the orbit, the elements of which were published by Mr. Adams in the Astronomical Society's Notice for May, 1847. Whatever artful stories may therefore be circulated, there will be one splendid fact to meet them; namely, that the planet, which Mr. Adams undoubtedly discovered, is still visible in the orbit which he determined.

PHILO EXONIENSIS.

* We intend doing so, but cannot conveniently find room for it in our present No.—ED. M. M.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Thomas Metcalfe, of High-street, Camden Town, Middlesex, gentleman, for improvements in the construction of chairs, sofas, and other articles of furniture for sitting or reclining on. October 5; six months.

Edward John Massey, of Liverpool, for improvements in apparatus for measuring the speed of vessels and streams, and for ascertaining the depths of water. October 5; six months.

Joseph Sharp Bailey, of Bradford, York, spinner, for certain improvements in preparing, combing, and drawing wool, alpaca, mohair, and other fibrous materials. October 5; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Sept. 29	1597	William Rowan	Belfast, engineer	Fluctuating slider.
30	1598	James Moor Martin	Walworth	Protector, or railway travelling cap.
„	1599	Alfred Augustus de Reginald Hely	Manchester-buildings, Westminster	Portable gaseous liquid fountain.
Oct. 2	1600	George Chambers & Co.,	Studley	Holder for crochets or tambour needle, a piercer, or other similar articles.
3	1601	Thomas Rontree & A. Brown	Liverpool	Improvements in stand and other pipes used for the conveyance of fluids.
4	1602	Prosper Alex. Lambert,	Bedford-street, Covent-garden	Improvements in the shape or configuration of mechanical or artificial leeches, and the lancets used therewith.
5	1603	George Fred. Morrell	Fleet-street	Abutments applicable to all arches and brestsummers.

NOTICES TO CORRESPONDENTS.

Mr. Hammerton's letter reached us at too late a period in the week for insertion this week, but it shall appear in our next.

Mr. Andrews also in our next.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co. Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1314.] SATURDAY, OCTOBER 14, 1848. [Price 3*d.*, Stamped, 4*d.*

Edited by J. C. Robertson, 166, Fleet-street.

COLE'S PATENT HIGH-PRESSURE AND EXPANSION DOUBLE CYLINDER BEAM ENGINE.

Fig. 1.

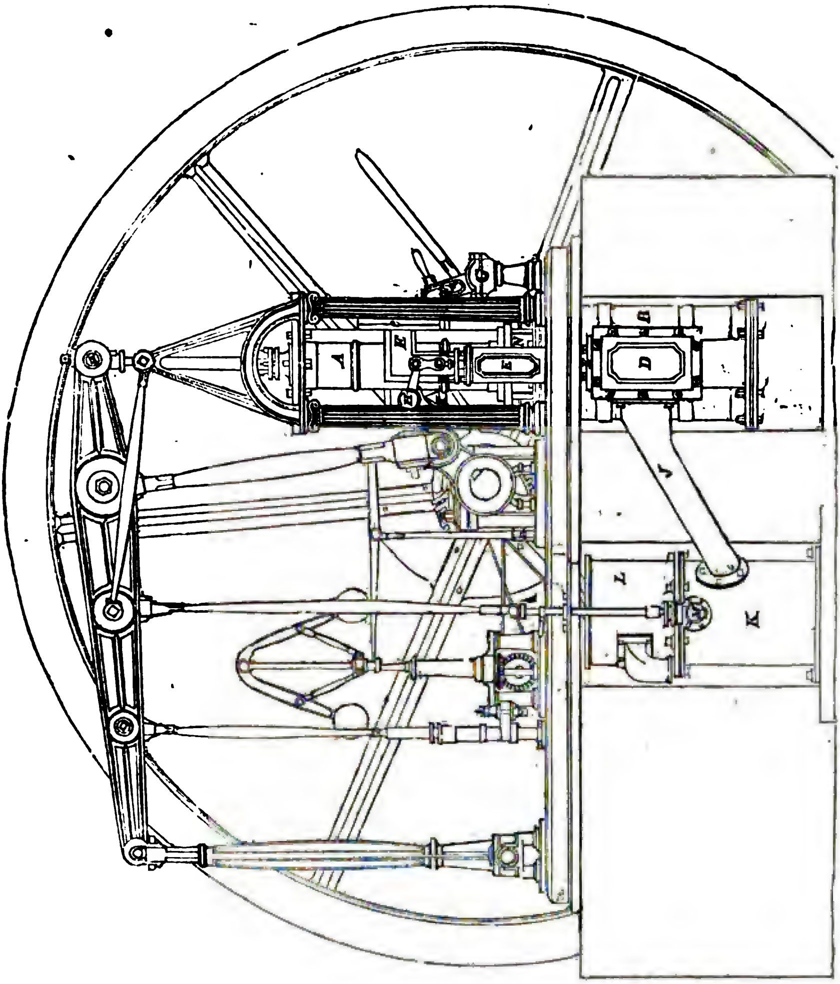


Fig. 3a.

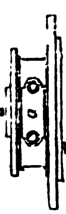


Fig. 3.

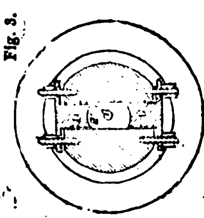


Fig. 3b.

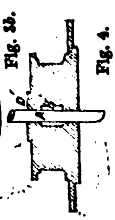
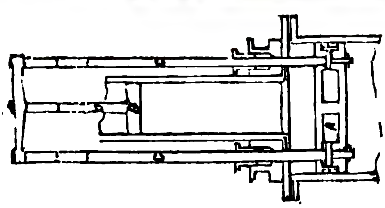


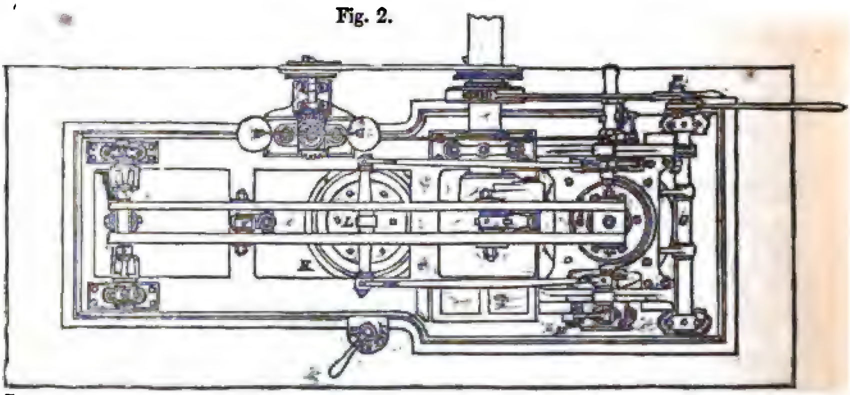
Fig. 4.



COLE'S PATENT HIGH-PRESSURE AND EXPANSION DOUBLE CYLINDER BEAM ENGINE.*

[Patent dated March 22, 1848. Specification enrolled September 22, 1848.]

Fig. 2.



The high-pressure and expansion engine of two cylinders, originally introduded (if not invented) by Hornblower, and subsequently improved by Woolf, the Halls, the Rennies, Craddock and others, is confessedly one of the most economical in point of consumption of fuel ever constructed; but there are two countervailing circumstances which have stood in the way of its more general adoption, namely, the large space which it occupies, even in its most improved forms, and its (comparatively) high price.

Both these objections Mr. Cole has made it his study to remove; and in this he has succeeded to an extent which makes it probable that we shall soon witness a very great increase in the demand for this class of engines. The means he has adopted consist simply in a better arrangement of the parts of the engine. Instead of placing the two cylinders side by side, he places the large, or expansion cylinder immediately underneath the small or high-pressure one, and connects the two by a stuffing-box, through which one piston, common to both cylinders, works.

Fig. 1 is a side elevation, and fig. 2, a plan of an engine thus constructed. A is the small, or high-pressure cylinder, and C its slide case; B, the large, or expansion cylinder, and D its slide case; N, the connecting stuffing-box, a plan elevation and section of which are given separately in figures 3, 3*a* and 3*b*. A^1 is the piston rod; B^1 the space for the packing, and O O, two packing glands; D^1 is a flange, which fits the interior of the small cylinder, and E^1, a flange, which fits the interior of the large cylinder; E E E are passages through which the steam passes from the small to the large cylinder, and in which also the slide rod of the large cylinder works; F is the eccentric pin; G, the way-shaft of the small cylinder; H, the way-shaft of the large cylinder, to which motion is communicated by the rod I; J is the eduction pipe from the large cylinder to the condenser K, in the centre of which is placed the air-pump; L is the hot well, and M the injection pipe.

From this description it will be seen that little more is necessary to convert an ordinary high-pressure beam engine into one on this improved plan, than the addition of the extra large cylinder, which is accomplished without any increase whatever in the ground area occupied, while the expense of that addition is as nothing compared with the immense saving in fuel to to be realized by working the steam on the high pressure and expansion system combined.

The stuffing-box N, may be dispensed

* Manufactured by Messrs. Gilbert & Co., Engine Works, Boston-street, Hackney-road.

with by having two piston rods to the large piston passing through stuffing boxes in the cover of the large cylinder one on each side of the small cylinder, as represented in fig. 4. A is the piston of the large cylinder, and B the piston of the small cylinder. The piston-rods C C, of the large cylinder, and the piston rod D of the small cylinder, are all connected to the same cross head.

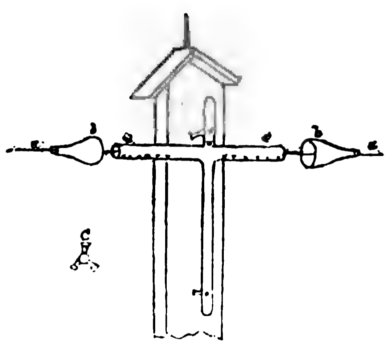
THE ELECTRIC TELEGRAPH.—IMPROVED MODE OF INSULATION.

Sir,—Being a monthly subscriber to your invaluable Magazine, I was unaware until this morning of the supposed improved method of insulating electric telegraph wires proposed by Mr. Hammerton, in No. 1310.

As it is a subject which possesses uncommon importance to the public, I will, with your permission, offer a few remarks upon the method he introduces. Gutta percha has long been known as a perfect non-conductor of electricity. It may be easily moulded into almost any form, and is eminently calculated for telegraphic purposes. It was, and still is known to almost every person, that gutta percha may be so applied; consequently, I do not see that the merit of first discovering this material as a non-conducting agent and substitute for the purpose mentioned can justly be claimed by Mr. Hammerton. But I do not wish to dispute with him the merit of using it; I merely wish to learn what improvement he has effected by the adoption of the gutta percha *tubes* in place of the old earthenware insulators. Several letters have been written to you on this subject, but not one of them seems to notice, that practically it *is no* improvement. Mr. H. says "as a substitute for the earthenware cones at present in use for suspending the wires to the poles, I propose screwing on to the poles a piece of inch and half or other convenient-sized batten of the required length. Gutta percha tubes 12 or 14 inches long, and widened into a lip at the extremities, are then strung upon the wires and attached upon the poles by a plate of zinc shaped to the form of the tubes." But he does not state whether the tubes fit *closely* to the wires, or whether they leave sufficient space to prevent contact; if the latter, how are they supported in the centre of the tubes? I see no mention made of this; were they supported in the centre of the tubes I admit a slight improvement would be effected, when considered relatively with other subjunctive circumstances, to which I will presently advert. We are at present compelled to conclude that the gutta percha tubes fit closely to the wires, or at least, that they are in contact with them. If this be the case, in what consists their superiority over the earthenware insulator? The object is to perfectly insulate the wires from the post and *from each other*. Let us see if this has been effected in a superior manner to the old method.

In wet weather the outside surfaces of the tubes would of course become wet, and in that state tolerably good conductors; a little wind would suffice to drive the rain into the enclosure of the lips and thus a connection would be formed, not only with the earth, but with all the insulators; the supposed zinc belts would offer increased facilities of communication one with the other. But it is not exactly the rain which causes the connection; it is the heavy mists (particularly heavy at night) or a fine penetrating drizzling rain which are the greater enemies to the telegraph. Irrespective of the form, where is the superiority of the gutta percha over the earthenware insulator? Does gutta percha possess the same valuable property as glazed earthenware, viz.: that of collecting the water in drops instead of allowing it to diffuse itself equally over the surface of the insulator? I believe not. In that case it would prove very inferior to earthenware; it has frequently occurred in my own experience, that during very heavy showers extending over a distance of forty or fifty miles, no difference could be perceived in the strength and certainty of the signals, by reason of the insulators being *glazed* and collecting the water in *drops*. Gutta percha does not, I believe, present this advantage. A storm would saturate the tubes, or cause them to become damp, sufficiently so to become conductors; and thus, I humbly conceive, are they inferior, both in point of matetérial and form, durability and economy, to those on the old plan. Let the gutta percha tubes be 12 inches or 12 yards in

length, the effect is the same. They become wet throughout their entire surface from a connection with the post, the earth, and with each other. I will take this opportunity to mention a plan of insulation somewhat similar to Mr. H.'s, but differing in one or two essential points, and which I thought of as far back as January last. I do not say that it is perfect—far from it; but still it may be an improvement, however slight, upon the present system. For convenience of illustration I will use one insulator only: I should use a glazed earthenware tube about 6 or 7 inches long, and 1 inch in diameter, perforated at the bottom with a number of small holes (represented in the figure), to within an inch of the centre on either side. In the middle of the tube I should place a piece of glazed earthenware, C, with three radii forming an arch; the wire would pass through this centre piece and the tube: then, at both extremities of the tube, and on the wire, I should fix a piece of earthenware, *bb*, about an inch and three-quarters in diameter, pear-shaped, and hollow; these would be fixed on the wire, as represented, but overlapping both ends of the tube about one inch, as far as the upright marks, *ee*, but not in contact with it.



Were insulators made after this plan, I think an improvement would be effected upon the present system: the caps, *e e*, would effectually prevent the admission of water within the tube, while the perforations in the bottom would draw off any small quantity of water which might find its way there, thus keeping the centre-piece, C, through which the wire, *aa*, would pass, perfectly dry; that is, I think, the object aimed at. Even when the atmosphere was loaded with vapour, the caps would form good protectors to the centre piece inside the tube. The subjunctive circumstances to Mr. H.'s method which I promised to mention, are briefly as follows:—1st. That the tubes should be larger, and with a centrepiece as a support for the wire. 2nd. That the bottom of the tubes should be perforated. 3rd. That the extremities should be defended from the weather by pear-shaped pieces of earthenware, or other material, of course not in contact with the tube.

Fearing that I have already engrossed too much of your valuable space, and trusting that, for the sake of the science and the public generally, this letter will find a place in your columns,

I am, Sir, yours, &c.,

THOS. ANDREWS.

HORÆ ALGEBRAICÆ. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

(Continued from vol. xlviii., p. 183.)

VIII.—A NEW ALGEBRA.

I think that I am justified in stating that there is a species of algebra which has as yet received no attention from the cultivators of analysis; I mean the algebra of *impossible* quantities, or impossible expressions; for the term quantity is not strictly applicable to such cases.

In speaking of impossible quantities, I must be understood as all ding to something very different from the *unreal* or imaginary quantities of ordinary algebra. The term impossible is, it is true, often applied to the latter description of quantity; but I propose to restrict its meaning, and to use it in conformity with the definition which I am about to give of it.

Premising, then, that there are algebraic equations the very supposition of

the existence of which involves an arithmetical contradiction—equations which have no root whatever*—I shall designate such equations as *impossible*. Bearing this designation in mind:—

By an *impossible quantity* is meant a root of an *impossible equation*.

It appears to be a question whether there exists an equation without a root, at least it does not appear to be universally admitted that a literal or algebraic equation can ever represent an impossible relation. At page 128 of the twelfth (LUND'S) edition of WOOD'S Algebra, a congeneric surd equation is treated of, which, as may be readily shown, has not any root. But the learned editor, finding that the indicated solution does not fulfil the required conditions, is inclined to doubt whether it is not the process pursued which is at fault, and is not satisfied as to the nonexistence of any root whatever. I have elsewhere† adverted to this portion of Mr. LUND'S edition of the work just mentioned, and I believe that in previous periods of these *Horæ*, I have established, beyond all doubt, the existence of impossible equations‡. If I add that the validity of the process which I have employed for this purpose has been admitted§ by two eminent mathematical writers, who adorn the pages of the *Mechanics' Magazine* with their contributions, it is not to gratify the just pride which I feel in their approval, but to claim for the subject of impossible equations that importance of which the attention they have bestowed upon it is a sufficient proof.

As the impossible quantities mentioned in this paper must be carefully distinguished from the unreal quantities of ordinary occurrence in algebra, so also they must not be confounded with the unreal symbols of the quaternion theory of Sir W. R. HAMILTON, with which they have no connection whatever. Professor J. R. YOUNG* has expressly remarked that the quaternion theory is an addition to ordinary algebra of an "algebra altogether new." But the impossible quantities which we are about to consider, are inevitably forced upon our notice in the contemplation of expressions which ordinary algebra presents to us. Hence the admission of a symbol to denote impossible quantity—should such symbol ever be admitted—into works on algebra, would be an *extension* of and perhaps an *innovation* upon the previously existing science, and would, in fact, be a legitimate development of it.

In one of my "Chapters on Analytical Geometry," I have adverted† to the existence of a distinction that ought to be observed between the geometrical interpretations of unreal and of impossible quantities, between unreal space and impossible space, if we may use the word "space" with the same license as we have done the word "quantity." And unquestionably there is some such distinction. But it is more difficult to conceive a difference between unreal and impossible space than between unreal and impossible quantity. Of unreal space we can have no *conception* (strictly so called) whatever, and, consequently, it would seem at a first glance not to be a proper subject for geometrical contemplation; not so with unreal quantity, for, though we cannot conceive of it as we can of number, yet an algebraist of the SCHOOL OF PEACOCK‡ sees, in the occurrence of those quantities, an inevitable result of the laws imposed upon his symbols, and, consequently, a fit subject for, his researches.

Yet, difficult as the idea of unreal space may seem, it is not to be discarded from geometry. CHASLES has deemed the subject not unworthy of his consideration, and has devoted to it the twenty-

* Of such equations I have already given some discussions in the *Horæ Algebraicæ*. See *Mechanics' Magazine*, vol. xlvii., pp. 151 and 331, and vol. xlviii., p. 181. Consult also vol. xlvii., p. 307.

† *Mech. Mag.*, vol. xlvii., p. 151 (and p. 331); *Phil. Mag.*, s. iii., vol. xxxii., pp. 357-358.

‡ *Mech. Mag.*, vol. xlvii., pp. 151 and 331, and vol. xlviii., p. 181.

§ I allude to remarks of Professor J. R. YOUNG, in the *Mech. Mag.* (vol. xlvii., p. 546,) and of Professor T. S. DAVIES, in the *Phil. Mag.* (s. iii., vol. xxxii., p. 358.)

* See the third scholium to his paper "On an Extension of a Theorem of" EULER, &c., &c., published in Part II. of vol. xxi. of the *Transactions of the Royal Irish Academy*.

† *Mech. Mag.*, vol. xlviii., pp. 82-83.

‡ I use this expression, not with a view to assert that the DEAN OF ELY was the first to notice unreal quantities with a view to their application—such an assertion would be an error—but to express my opinion that Dr. PEACOCK'S Algebra is the standard work on the philosophy of that science, and that his views form a near approximation to those which will ultimately be received as forming the true basis of symbolical algebra. His views appear to form a basis somewhat analogous to the geometrical one which MONGE has taken in his principle of "contingent relations."

sixth note of his *Aperçu Historique.** For the explication of unreal (imaginary) entities in geometry, CHASLES has recourse to MONGE's method or principle of "contingent relations." Content with having cited this great authority in favour of attaching a geometrical validity to unreal space-entities, I shall carry no further my observations upon this point, but merely remark that the distinction between unreal and impossible space is now easily discernible, inasmuch as the latter has no geometrical existence or validity whatever.

An illustration of some of the preceding remarks will be found in the following two equations:—

$$x+\sqrt{2x}+1=0\ldots\ldots(1.)$$

and

$$x-\sqrt{2x}+1=0\ldots\ldots(2.)$$

in which equations, as, indeed, in all other cases, the sign prefixed to the radical is to be *strictly* adhered to.

[Whenever the sign of a square root is ambiguous, we may represent the root by attaching an index to the square, and thus, in fact, we shall have the following relation:—

$$a^{\frac{1}{2}}=\pm\sqrt{a}$$

the quantity of $\sqrt{a}$ being supposed to have only one value.] Now, bearing in mind that

$$\pm 2\sqrt{-1}=(1\pm\sqrt{-1})^2$$

we see that the equation (2.) is satisfied by making

$$x=\pm\sqrt{-1},$$

and, applying a process before referred to† we shall find that (1.) has *no* root. Hence the roots of (1.) are *impossible*, and that equation corresponds to an impossible space-entity. The roots of (2.) are two in number and *unreal*, and (2.) consequently represents two unreal points: x being, for purposes of geometrical interpretation, considered as an abscissa.

Let us now proceed to give some kind of system to this algebra of impossibles.

The ordinary algebra takes cognizance of three species of quantity;—positive, negative, and unreal. Perhaps the simplest forms under which these three kinds of quantity can be exhibited are the following:—

$$+1\quad;\quad-1\quad;\ \text{and}\ (-1)^{\frac{1}{2}};$$

which we may call

$$p\quad;\quad n\quad;\ \text{and}\ u\ ;$$

respectively. Now what is the corresponding simple representation of impossible quantity?

The process which I shall employ for the purpose of answering this question is as follows. I shall express p, n, and u by equations, and then, guided by the analogy afforded by them, I shall form a corresponding equation for an impossible quantity which I shall denote by i, and which will probably be the simplest equation by means of which impossible quantity can be exhibited.

Thus, p is the root of the equation

$$0=1-x;$$

so, n is the root of

$$0=1+x;$$

also u is a root of

$$0=1+x^2;$$

and, guided by analogy, I take i to be the root of

$$0=1+\sqrt{x}.$$

The root of this last equation may be shown to be impossible as follows:—

First, let x be positive, then we have the sum of two positive quantities equal to zero, which is absurd. Secondly, let x be negative, then we shall have a negative equal to an unreal quantity, which is absurd. Lastly, let x be of the form

$$\alpha+\beta\sqrt{-1}$$

then we should be conducted* to a relation of the form

$$1+\alpha'+\beta'\sqrt{-1}=0,$$

whence we obtain $\beta'=0$, and consequently $\beta=0$, and $x=$a real quantity which, as we have just seen, it cannot be.

Hence x is impossible. I need scarcely say that α, β, α', β', are all supposed to be real.

I shall next prove the same thing from principles already alluded to in this paper.†

Since

$$(1+\sqrt{x})\ (1-\sqrt{x})=1-x$$

* See pp. 368—370 of the work cited. See also § 17 of p. 207 of the same work.

† As to this process see the places already cited in a previous note (‡).

* As at p. 331 of vol. xlvii. of the *Mech. Mag.* Or consult Professor J. R. YOUNG's Algebra, (4th edition) p. 115, note.

† In connection with the places referred to in the third note to this paper, the reader may turn to pp. 409-410 of vol. xlvii. of the *Mech. Mag.*

no quantity other than unity can satisfy either of the equations

$$1+\sqrt{}=0 \text{ ......} (3.)$$

$$1-\sqrt{x}=0 \text{......} (4.)$$

without making the right hand side of the other equation infinite, for otherwise the equation

$$1-x=0$$

would have a root other than unity. Now unity does not satisfy (3.), hence if we suppose some other quantity i to do so, we shall have

$$1+\sqrt{i}=0$$

$$1-\sqrt{i}=\infty$$

whence, adding these equations, we have

$$2=\infty,$$

which is absurd. Hence i has not any existence except the symbolical one implied in (3.), and is not capable of being expressed by any such formula as

$$a'.p+b'.n+c'.u,$$

which (a', b', and c' being numbers) is the most general expression of ordinary algebra. The NEW ALGEBRA will treat of the relations which *symbolical impossibilities* bear to one another and to the ordinary relations of algebra, and its most general expression will be

$$a.p+b.n+c.u+d.i$$

where a, b, c, d are numbers.

If we were to attempt to express i by some numerical symbol with certain operations performed upon it, in the same manner as the unreal quantities of ordinary algebra are expressed, the expression

$$(-1)^{\frac{1}{2}}$$

would, I think, form an essential part of such expression. To make such attempt successful, we should, however, be compelled, if I am not mistaken, to limit our operations by some new convention respecting them.

Perhaps I shall be permitted to conclude with a digression respecting a portion of the Algebra of Professor YOUNG, of Belfast. I allude to the Ex. 8 of p. 130 of the fourth edition of that work, and the earlier portion of the NOTE which follows it. With that respect which the Professor so well deserves, I would remark, that I cannot help considering the value $x=5$ as a solution of the example, not only when the radical is taken positively, but also when it is taken *negatively*. It is true that our result becomes in such case

$$-0=+0,$$

to which an objection might be taken; but an equally strong one might be taken to the solution in the case when the radical is taken positively, for then we have, from the conditions of the question

$$\sqrt{9.0}(=3.0)=2.0.$$

I think that both solutions are valid. May we then substitute for the first and second periods of the NOTE in question, a statement that the value $x=5$ is a solution of *both* the congeneric surd equations involved in the example, and that it is so, only in consequence of the equations

$$2x-10=0$$

and

$$(4+x)(5-x)=0$$

having a *common root?*

2, Church-yard-court, Temple,
September 14, 1848.

MATHEMATICAL PERIODICALS.

(Continued from page 306.)

X. *The Scientific Receptacle.*

Origin.—This periodical was commenced at Holbeach, in Lincolnshire, on January 1st, 1825, and was intended "to elicit the latent spark of genius, to create a generous and laudable emulation among the youthful votaries of science, to disseminate useful and entertaining knowledge, and to open a field for the recreation and exertion of the adept in mathematics." It was discontinued, so far as I am aware, with the fourth number, in October, 1825, and forms a small volume of vi + 366 pages.

Editor.—Mr. Henry Clay, teacher of the mathematics, &c., Moulton, Lincolnshire.

Contents.—Agreeably to the plan of several similar publications, this work was divided into *junior* and *senior* departments. In the "Juvenile Department" are found "Prize Subjects in Latin and French;" "Translations from the Latin and French," for which prizes were awarded; "English Themes;" and a series of mathematical questions for youth. The *senior* department contains "Original Essays;" "Miscellaneous Correspondence;" "Queries and Answers;" "Original Poetry;" "Enigmas, Charades, Rebusses, Anagrams," and answers; and a selection of mathematical questions for the exercise of "the little band of mathematicians" who had enlisted in the editor's service. Among

the essays may be noticed those "On the Utility of Mathematical Learning;" "Observations on the Effects Produced on the Mind by the Study of the Mathematics," by Mr. Wm. Stringer; and another on "Youth," by "Zeno." The Miscellaneous Correspondence contains a paper "On the Longitude of the Observatory of Paramatta," by James Jerwood, Esq.; and some good remarks on the utility of such works as the *Receptacle* in "Schools," by "Clericus." The Queries contain much that is curious and useful. Messrs. Baines, Gillott, Jerwood, &c., appear to have taken much interest in this portion of the work. The 20th query, by Mr. Jerwood, asks if "the radical properties of triangles can be deduced, *à priori*, from the theory of functions?" and an answer in the *negative* is given by "N'Importe." (*query* the editor?) which adduces the principal arguments on the subject from Legendre and Leslie. In the poetical department, "The Medley," several of the pieces by Mr. Clare; two compositions by Mr. John Baines, on the deaths of Samuel Johnson and John Ryley, the well-known mathematicians; and some others, may be read with interest.

Questions.—The total number of mathematical questions proposed and answered in this periodical is 76, of which the first 21 were chiefly selected from those left unanswered in the *Leeds Correspondent*.

Of the whole, 2 belong to pure Algebra; 5 to the application of Algebra to Geometry, &c.; 1 to Series: 3 to Trigonometry; 3 to Mechanics; 6 to Fluxions; 14 to the Diophantine Analysis; 22 to questions on Loci, Quadrature, and Rectification of Curves; and 20 to Geometry, geometrical analysis, and construction. Many of these form important and valuable exercises for the student; the investigations of Messrs. Baines, Beverley, Godward, Rutherford, and Gill, are both numerous and elegant: the differential notation is principally employed; and in many of the quadratures, &c., the results are obtained by means of the *polar* equations of the curves. The 20th question is an elegant property of the quadrilateral, proposed by Mr. T. S. Davies, *then* of Leeds, and answered by Mr. Rutherford. The 76th is compounded of two porisms; it was proposed by Professor Gill, and was answered by himself and Mr. Thomas Thompson, of Newcastle.

Contributors.—Messrs. Baines, Beverley, Brierley, Davies, Ellis, Fielding, Gill, Gillott, Godward, Hattersley, Holt, Hudspeth, Huntington, Jerwood, Laputiensis, Lightbourn, Macann, Macauley, Newton, Rutherford, Ryley (Rylands,) Settle, Shepherd, Sim, Stringer, Thompson, Todd, Whitley (Geometricus), Winward, &c.

Publication.—It was published in quarterly numbers, printed by and for the proprietor, C. F. Pitman, Holbeach, and was sold in London by G. B. Whittaker, Ave Maria-lane.

THOMAS WILKINSON.

Burnley, Lancashire,
October 3, 1848.

THE EDDYSTONE LIGHT-HOUSE AND THE VERTICAL-WALL QUESTION.

Sir,—The writer of the article in your last Number, p. 342, is very much mistaken in citing the Eddystone Lighthouse as an instance of the superiority of the vertical wall. Sir Howard Douglas in his Protest refers to it as furnishing on the contrary conclusive evidence of the stability of a long curved slope for the basis of a superstructure exposed to the action of the waves; and Smeaton, who built it, professed, as is well known, to have taken the oak for his model, which rising with a gentle curve from a broad base, withstands the storms and tempests of a thousand years. If the Eddystone had been a square tower with upright plane faces, it would not have survived the first severe gale. By being round in the body and concave at the base it presents no plane surface to the action of the sea; and hence its well-proved stability. Even Professor Airy admits in his evidence that the Eddystone is a good construction of the slope face base with a nearly upright face for the superstructure.

I am, Sir, &c.,

H.

GENERAL SIR HOWARD DOUGLAS'S "PROTEST."

Sir,—I am one of those readers of your excellent miscellany who desire instruction, information, and amusement, in perusing and studying its contents, and who must have felt some surprise at

Mr. Smith's want of accuracy and of courtesy.

The author of the very able article which appeared in your last Number, shows clearly the fallacy of Mr. Smith's criticism—that in the case stated in the note to the Protest and the diagram, it is not the *length* of the inclined plane or slope, but the *height* that is given, in which case the quantity of fluid which strikes the plane is constant, and not as the sin ϕ_1, and that therefore the whole effect is as the square of sin ϕ.

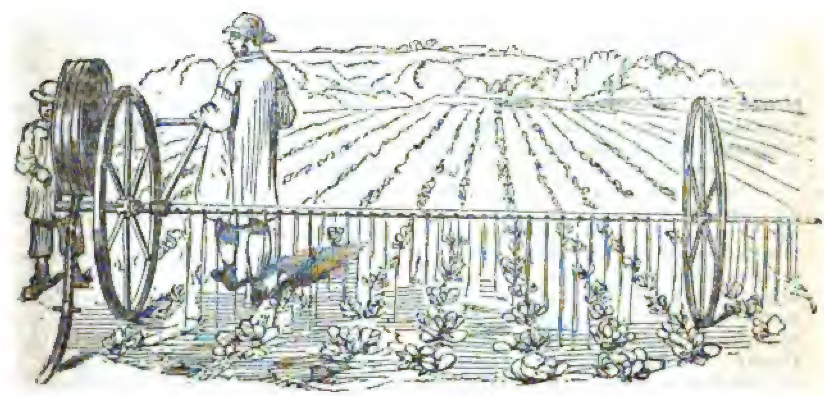
With respect to the alleged error in notation, I perceive that the "P. D." acknowledges it to have been one of the press; but it may be remarked, after all, that the notation sin θ^2 is not really erroneous; it has been used by some eminent mathematicians, but it is not so free from ambiguity as $(\sin\theta)^2$ or $\sin^2\theta$. See "Cape's Mathematics," p. 456, Note 3d, Ed.

I am, Sir, yours, &c.,

A CONSTANT READER.

MR. COODE'S PATENT SYSTEM OF LIQUID MANURE DISTRIBUTION.

[Patent dated March 11, 1840. Patentee, George Coode, of Haydock Park, Esq. Specification enrolled September 11, 1848.]



The improved system of distribution which forms the subject of this patent is the final result, we understand, of a long series of experiments instituted by Mr. Coode for the purpose of facilitating the solution *quoad hoc* of that great compound problem of the day, namely—*How to help the people to more food and more health to enjoy it;* or, in other words, *how to make the sanitary improvement of our towns contributory to the fertilization of the country;* and it is a system which possesses the recommendation of being already in full and successful operation, on a large farm in Lancashire, in the patentee's own occupation.

Mr. Coode uses a distributor of three several varieties, which are called the *parallel*, the *radial*, and the *diametral*, but are all constructed to a certain extent in the same way and on the same general principles. The apparatus consists in every case of two main parts; *first*, a delivery-pipe, which is a long tube perforated all over, or in certain parts only, with holes for the delivery of the liquid or liquid matter, and which is made either of some rigid material, as metal or wood, or of some flexible fabric, as canvass inclosed in a rigid framework or cradle; and, *second*, of a flexible hose for feeding the delivery-pipe.

Mr. Coode describes each of the varieties of the apparatus separately; but gives previously the following general instructions:

When the pipe is of metal, or of other substance, even and smooth on the inside, it should be made of a strictly conical shape

from the feeding place to its end. But when the delivery-pipe is of wood, or of any absorbent substance, rough, or unequal on the interior surface, the friction of the liquid or liquid substance on the inside of the tube must be compensated by a proportionate enlargement of the tube towards the feeding end. Thus, in a tube of pine wood 24 feet in length, intended to deliver a stream of two inches in diameter, it is necessary that the cone should be of about three inches in diameter, between the feeding point and the first perforation for delivery.

The sum of the sectional areas of the perforations for delivery must always be equal to, or at least never exceed, the sectional area of the volume of liquid or liquid substance to be supplied to the tube.

Mr. Coode then describes the three forms of his apparatus as follows:

The Parallel Distributor.

In this case the delivery-pipe is moved in a direction at right angles to its axis, and is pierced with perforations of equal dimensions placed at equal distances. For more convenient motion, the tube may be placed on two wheels, of which the tube itself, when rigid, and its framework, when flexible, may serve as the axle. One wheel should be placed near the feeding end of the tube and should be a little stronger than the other on account of the extra weight which it has to bear; and the other wheel may be most conveniently placed at about one-third of the length of the tube from the other extremity. The latter wheel should be moveable, so as to be placed at various distances from the first, to accommodate the ridges or other divisions of the land, over which the liquid or liquid substance is to be diffused.

There are two modes in which this parallel distributor may be supplied from the hose.

In the first mode the hose is made in convenient lengths, say 40 yards, each having at the several ends respectively, male and female union screw joints; and the pieces are laid in succession on the surface to be watered, and in the direction in which the apparatus is to be moved, in a double bent form like the letter U. One end of the hose being connected with the tank, reservoir, pump, or other source of supply, by one of the joints, say the female screw, the other end is attached by its male joint to the feeding end of the distributor, which carries a female joint. The distributor being moved forward, drags with it the end of the hose, until the whole is pulled out straight, when a compressor is put on it to prevent the further outflow of the liquid and to enable the hose to be detached from the distributor and connected with another joint of hose, laid as before, and which in its turn is connected with the distributor. The compressor being taken off the first hose, the liquid flows through the second to the distributor, which proceeds as before, and so on, *toties quoties*. When the distributor has traversed the whole length of the field or surface to be watered, it is brought back along the other side of the length of hose, dragging them successively into the original position in which they were laid and being successively detached from them.

The compressor which has been spoken of, may be made of strong wire twisted into a rectangular form, with one end returned, or nearly so, to one of the shorter sides of the rectangle, so as to hold fast a tongue of similar wire, but of twice the strength, which turns in the opposite short side of the rectangle; or it may consist of two metal jaws hinged together and capable of being brought tightly together by means of a screw—a form of construction to be preferred where the liquid or liquid substance in the hose is under great pressure.

The second mode in which the parallel distributor may be supplied from the hose is as follows. The delivery pipe carries either on itself, as an axis, or by arms fastened to it, a reel. Round this reel a coil of hose (say 36 yards in length) is wound, one end of this coiled hose being permanently connected with the delivery pipe, and the other carrying (say) the female screw of the union joint. With this parallel distributor I use a hose to supply it made in pieces of any convenient length (say 200 yards), furnished at their ends with union joints. At intervals equal to the length of the hose coiled on the reel, there are T pieces furnished with male or female screws as the case may be, and at each T joint there is placed a compressor. The distributor being brought in succession to each T joint, and the coiled hose attached to it, the liquid or liquid substance flows through the coil into the implement, which is then moved on towards the next T joint, the coil unreeling as it advances. When the coil is unreeled, and the implement arrives at another T joint, the compressor is placed over the last T joint, the coil detached from it and gathered up, and again wound round the reel which is now connected with the second T joint, near which the implement stands, and the compressor being taken off the first T joint, the implement is moved on as before, and so on *toties quoties*. The coil is made of sailcloth or other strong fabric sewed into a tube. A line is inserted in the seam of less length

than the fabric, so that the tube is shortened on the side of the seam, which gives a circular form to the coil when distended with liquid and causes it to cling to the reel.

The gathering up of the coil is effected by taking up its detached end and fastening it to a separate reel, the axis of which is placed on wheels. This reel being rolled towards the implement gathers up the coil. When it has arrived at the place of the implement, the coil may be wound off upon the reel of the implement; or the reels may be so made as to replace each other with the coil carried upon them.

The Radial Distributor.

In this case the delivery pipe is moved radially from a central point, its point of connection with the feeding hose being the centre of the circle. It is pierced with perforations increasing in number or sectional area as the square of the distance from the centre. For convenience in use, this form of distributor is supported at its feeding end by a pivot moving in a tripod. At a convenient distance towards the other end, it is supported by a pivot moving in a carriage with two wheels, which turn like the four wheels of a carriage, and may be moved by a rod in the hand of the workman into a position either parallel to the tube or at right angles to it, as may be required in moving it tangentially or parallel to its axis.

The hose to supply this radial distributor is provided with T joints, as before described, but the T joints are placed in this case at the distance of twice the length of the tube, less the versed sine of 60°, the tube being the radius. The tube being turned round, the T joint will describe a circle, but each circle will overlay a portion of each adjoining circle.

To prevent a double distribution at the points of intersection, the passage of the liquid is stopped by either of the following means:—When the tube consists of a flexible substance, such as canvass, the tube itself is compressed on the outside by means of a wheel moving in a block fastened to an arm placed parallel to the bottom of the tube, which block and wheel may be pulled to or pushed from the feeding end by means of a line and pulley. When the tube is of rigid material, a ball valve is placed inside the tube, playing within the whole distance from the extremity of the *versed sine* of 60°, the tube being the radius; and through the ball a pulley line is passed, by which it may be moved to and fro in that space.

The Diametral Distributor.

The delivery pipe in this case is placed at the middle, on a standard, and moves on it as the double radius or diameter of a circle. It covers a circle in one half revolution. It is pierced with perforations, increasing from the middle to both extremities in number or sectional area as the square of the distance. The standard consists of a hollow tube, moving by a telescope joint in another, which carries the screw (say the female screw) of the union joint. The standard is fixed in a carriage similar to a wheelbarrow.

The hose is similar to that used with the radial distributor; but the T joints are at the distance of one diameter less the versed sine of 60°, the tube being the diameter. To prevent double distribution at the intersection of the circles, the passage of the stream of liquid is controlled in the same way as is described in the case of the radial distributor.

The prefixed engraving exhibits a view of the system as seen in actual operation.

APPLICATION OF ELECTRO-MAGNETISM AS A POWER IN MR. FRASER'S ENGINE.

Sir,—In your last monthly part, I observe a letter from Mr. W. Fraser, on an electro-motive engine of his construction. Having, for several years past, paid considerable attention to the subject, I regret that instead of hailing the proposed method as a valuable one, I am compelled to dissent from the conclusions of the ingenious writer; and I shall accordingly endeavour to show, that, in this instance at least, an imitation of the supposed *modus operandi* of Nature is not likely to be productive of a practically valuable motive power, capable of competing with the steam-engine. I shall be brief in my remarks, and confine them to the mechanical and electro-magnetic parts of the subject.

The chief difficulty in the application of electro-magnetism to the propulsion of machinery, arises from the necessity of an almost infinitely rapid motion of the magnets, to produce a result of any *practical* value. In the ordinary rotary magnetic machine, each impulse is repeated a very great number of times in a second; and in this way, with a small battery, some amount of mechanical force is obtained, but it is still insufficient for any but trifling work. Thus—suppose a set of six electro-magnets of the size named by Mr. Fraser, to revolve in a circle, and at equal distances, at the periphery of this circle, let six other

similar magnets be firmly fixed, and nearly touched by the other magnets, in their revolution. Say that a speed is attained of 300 revolutions per minute. The mechanical result of this arrangement would then be as follows. Each electro-magnet, in approaching that fixed magnet nearest to it, exerts an assumed force of 3lbs. through one-twelfth of an inch. In an entire revolution, each magnet would repeat this operation 6 times, and the whole 6 magnets of course 36 times. In the course of one minute, (and *time* is everything in calculations of mechanical effect,) the following will have been the result: 300 revolutions, each having 36 operations of the force of one magnet, will give 10,800 impulses; and each impulse being equal to 3lbs. raised through $\frac{1}{12}$th of an inch, the total effect will be $10{,}800 \times 3$lbs. $\times \frac{1}{12}$ inch, or 225lbs. through 1 foot per minute—the machine having the great advantage of a rotary, instead of a reciprocating motion. Let us now compare this result with that to be looked for from Mr. Fraser's engine. On his method, 2lbs. are raised through 8 inches, by the vibration (so to speak) of 96 magnets. This alternating motion could not, probably, be made to take place more rapidly than 150 times per minute; the following therefore would be the effect: 150×2lbs. $\times 8$ in. $=$ 200lbs. raised 1 foot per minute, or less than the power derived from 12 magnets only, on the ordinary rotary plan. I need scarcely remind the practical man, that its applicability to machinery is incomparably more difficult than that of the continuous rotary arrangement.

But it will readily be seen, on a little consideration, assisted by a sketch, that if the 96 magnets (in place of 12) were arranged on the common rotary plan, (viz., 48 fixed, and 48 revolving,) the number of changes of the galvanic current by the commutator, that is, the number of reiterated mechanical effects of *one* magnet, would be as follows: at 300 revolutions per minute, each revolving magnet would act upon 48 fixed magnets, 300 times in the minute, or 14,400 times per minute; and as each of the revolving magnets acts similarly, the whole 48 would give 48 times this number of impulses, or 691,200 in the minute. This would be equal, on the foregoing estimate of the value of each impulse, to 14,400lbs. raised 1 foot per minute—or less than half a horse-power. With double the number of magnets, the effect would be 4 times this, without requiring more than (if as much as) double the battery power. This follows simply from 96×96 being 4 times 48×48; and it will be found on calculation, that the effect of the 96 magnets, as given above, is 64 (or the square of 8) times that of the 12 magnets before computed. I have thus, I hope, shown that the common arrangement of 96 magnets would give more than 60 times the useful effect of the same number of magnets, arranged on the plan suggested by Mr. Fraser.

The enormous cost and complication of the apparatus proposed by that gentleman may be conceived, when it is recollected that nearly *ten thousand* magnets would afford little more than half a horse-power. The battery power required would also be very great indeed. And here I would beg to remark that he is quite inaccurate in supposing that a battery of a given size will cause the circulation of a galvanic current through any length of wire. In order to effect this, the wire must be so greatly enlarged, as to make it inapplicable to the coils of the electro-magnets; and since the electro-magnetic attraction is proportional to the *number* of the coils, this objection in itself would be of the most serious kind.

I need scarcely observe, also, that no mechanical advantage would be derived from the connection of the magnets by an elastic medium.

I beg to submit the following as the conclusions to which I have come on this interesting subject:—

The electro-magnetic current flows with an almost infinite velocity, and, therefore, the object of the practical man is to form such an arrangement, that the direction of a given current may be suspended, or changed, an almost infinite number of times in a minute. This is not to be sought for by increasing the *number* of the magnets; for this would involve not only a greatly increased expense, but also a proportionably great battery power, to force the current through a longer length of copper wire of the ordinary size. The desideratum is, to arrange a comparatively small number of magnets in such a manner, that their mutual impulses may be repeated an in-

conceivably great number of times in a minute. I have before shown that by employing 96 magnets on the usual plan, more than half a million repetitions of the attractive force of one magnet towards another would be obtained in a single minute. But this is quite insufficient. I have for a long time matured a plan by which, with the same number of magnets, quantity of copper wire, and consequently surface of battery, this number may be multiplied 4 times; but even this does not make it worth while to construct an engine.

In order, if possible, to make my meaning more clear, and by so doing, perhaps to induce some who have not hitherto thought on the subject, to turn their attention towards forming an efficient arrangement, I will conclude this letter with a few remarks. It is generally supposed that the electro-magnetic current travels with a velocity equal to that of light, or about 200,000 miles in a second. Now suppose a coil of 200 feet of copper wire wound around a bar of soft iron, one inch in diameter, and a piece of iron (or, better, a similar magnet) placed within, say an inch, of this bar, the *average* attractive force, (as I have ascertained from very carefully experimenting on such a bar,) would be 4lbs. 7 oz. through the inch. Were it possible, therefore, for the iron keeper, or the other magnet, to be attracted and repelled a *million* times in a second, by any mechanical arrangement, the speed of the electro-magnetic current along the coil of 200 feet would be less than half that at which it is computed to travel; whilst the mechanical effect, with one magnet, and a small battery would be enormously great. Of course this rapidity of motion of one magnet being utterly out of the question, the object is to arrange the smallest possible number of magnets, in such a way as to give the greatest possible number of changes of direction of the current; for, be it remembered, that every change of its direction, if properly applied, is equivalent to an effective force of nearly 4½lbs. through an inch. I hope I have already shown that whilst 96 *separate sets* of 2 magnets, reciprocating at their utmost attainable speed, would only multiply the effect of 2 such magnets *by* 96; yet, by a better arrangement of the 192 magnets, *without any increase of battery power*, the effect will be 9216 times that of the former. I am aware that it is said, there is a limit to the number of changes of direction of the current, owing to the impossibility of getting iron and copper wire so soft as to be entirely devoid of all retention of the original direction of the current; but I am not aware to what extent this important objection exists.

Earnestly wishing, and yet almost despairing to see any effective and economical application of electro-magnetism to the propulsion of machinery,

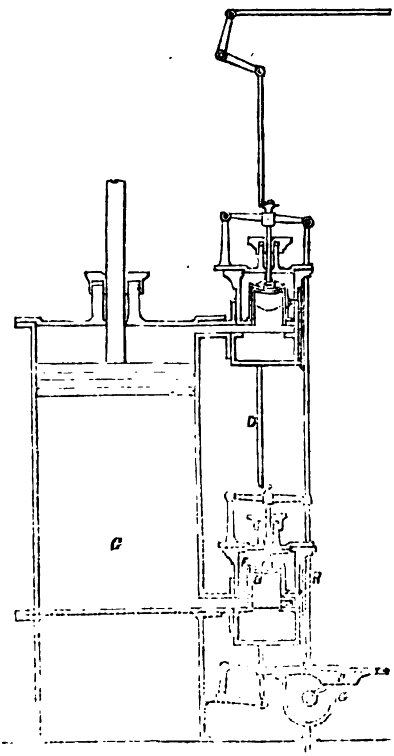
I am, Sir, yours, &c.,

F. F.

Newport, Mon., October 3, 1848.

ROWAN'S FLUCTUATING STEAM-ENGINE SLIDER.

[Registered under the Act for the Protection of Articles of Utility. William Rowan, of the New York-street Foundry, Belfast, Engineer, Inventor and Proprietor.]



The slider which forms the subject of this registration is intended to be used as

an appendage to steam engines, and to serve the purpose of regulating the admission of steam to the cylinders, according to the varying duty to be performed by the engine. Fig. 1 is a sectional elevation of a condensing engine with this slide applied thereto. A is the slide; C, the frame for slide; B, expansion valve; R, a rod which connects the frame of the slide with the valve; D, a rod leading from the slider to the governor; G, cylinder of the engine; F, valve-box.

The operation of the slider will be at once obvious upon an inspection of the figure. When the engine is brought up to the required speed, the governor balls are half extended; and when any extra load is put on the engine, the balls, of course, converge towards each other, and shift the "slider" in the frame so as to hold the valve longer up. When any of the machinery is thrown off, the balls extend; consequently, the "slider" is shifted as before stated, and cuts off the steam sooner, so that the engine adapts itself to whatever load is put on.

ON THE PRINCIPLES OF ALGEBRA, AS A SYSTEM OF GENERAL REASONING; WITH A SKETCH OF ITS RECENT PROGRESS, AND A REFERENCE TO SOME RECENT PAPERS IN THE "MECHANICS' MAGAZINE."

(Continued from page 348.)

From the preceding observations it will be evident that the employment of symbolical language does in no way preclude, nor can, indeed, from the nature of things, supply the place of reasoning. Purely mechanical, as the greater part of every algebraic process is, it is nevertheless true that every step in it is the expression of an argument or logical deduction, and the conclusion as irrefragable as the conclusion of any proposition in Euclid. We have seen in the course of the foregoing remarks that even the processes of arithmetic are mechanical also; and now we go further, and assert that language—common language itself—is essentially, like algebra, a mechanical medium by which reasoning is expressed. Reasoning itself is, as every one knows, a purely mental operation, not absolutely requiring any external aid or instrument whatever. As I have had occasion to remark in another place, the phrase *mathematical reasoning* is an incorrect one, and conveys a false notion. In mathematics the reasoning is about things more clearly and perfectly understood than in other departments of knowledge; but still it is of the same nature and cannot be of any other. And with regard to the necessity of an external aid, such as language, the reader who has any doubts had better refer to Brown's confutation of the opinion of Dugald Stewart, and of what are termed the "Nominalists," who very strangely believe that "general reasoning" could not be carried on without the use of general terms or words. (See Lectures, 46, 47, &c.) Such terms, and the other parts of our ordinary language, or symbolical expressions of some kind (such as those of the deaf and dumb) are necessary in order to convey to others the ideas and reasoning in our own minds; and not only does language serve this purpose, but it also very materially aids us in our own internal reasonings. In one sense it may be said indeed to be essential—for in long chains of reasoning our memory would fail, and whilst grasping firmly the latter portion, the earlier part would have slipped away, and we should be unable to see the connection between the beginning and end. Algebra, by chronicling each successive step, relieves the mind from this intolerable burden without impairing the strength of the evidence. But this is not all. The very nature of a symbol leads to the generalization of its meaning. That letter (or whatever the symbol be) which was at first used merely to denote some one particular thing, comes in the course of time to be looked upon as representing other things —or at least the possibility of its representing other things is suggested. Hence the inquiry arises—may not what has been proved for this one thing be true also of others? May not that which I have proved to be true for (x) when this symbol is supposed to signify the number *three*, be true also when (x) is supposed to denote the number *four* or *six*, or any other number? Such a question can obviously be decided only in one way, namely, by referring to the conditions

under which the proposition was originally obtained. In the endeavour to distinguish the essential conditions from the non-essential, or rather from the purely accidental circumstances, clearer and more comprehensive views are obtained. The inquiry may still go on further, and the question next asked be, whether it is essential that (x) should denote a *number* at all—what reason is there why it should not signify some operation of a totally different nature? And so the generalization goes on and on, and new truths are gathered in, and the view grows more comprehensive, and the connection of various departments of science becomes clearer and stronger, and analogies, at first dimly discerned, expand into identity of natures—until from one solitary idea there has been created a science.

The nature of analogy itself, is perhaps better illustrated by the extension of algebraical theorems than in any other way: what is at first looked upon as merely a curious similarity, or an entirely fortuitous coincidence, on a closer inspection and more rigorous examination turns out to be the necessary result of some common principle. It is rather a remarkable fact, that the force of analogical reasoning is generally *felt* to be much greater by the mind, than people allow themselves openly to confess. In connection with this subject every one will immediately be reminded of that magnificent work, "Butler's Analogy;" in the preface to which the author says, "It is not my design to inquire further into the nature, the foundation, and measure of probability; or whence it proceeds that *likeness* should beget that presumption, opinion, and full conviction, which the human mind is formed to receive from it, and which it does necessarily produce in every one; or to guard against the errors to which reasoning from analogy is liable. This belongs to the subject of logic; and is a part of that subject which has not yet been thoroughly considered." It is greatly to be regretted that this task was not undertaken by him who was so competent to do it justice. As a matter of observation, most persons must have noticed how much more ready than others some are to seize on analogies in the various branches of science. This is partly owing to a more or less extended acquaintance with these various departments, but the force with which such analogies are felt, is often very different in two persons, who yet have a nearly equal knowledge of the facts themselves, *as facts*. The reason being simply that one of these persons has more clearly distinguished between the essential and the non-essential circumstances accompanying the facts. When it is remembered how much physical science has been advanced by the contemplation of such analogies, the utility and importance of clear conceptions of the nature and evidence of analogical reasoning cannot fail to be seen; and the merely practical man, or one who cares only for the results of scientific inquiry without any appreciation of the beauty of the inquiry itself, may nevertheless be convinced that purely abstract reasoning and the examination of its processes is highly advantageous, and even necessary, to the progress of his own chosen department of knowledge.

So much for the advantages of using symbolical language, by which I mean any kind of algebra. But if we come now to examine attentively, wherein this differs from ordinary language, many of the apparent differences will vanish away before our eyes.

The words of the English, or any other, language, are *symbols* used to represent ideas and mental operations, as well as external objects. These symbols are connected together by what may be called, certain "Laws of Combination." And when so combined they form propositions and express truths. When definite meanings are attached to these symbols, or words, the laws of combination, according to which propositions are framed, become *necessary* laws—necessary from the very nature of the ideas or things signified. Different nations have different symbols to represent the same thing; but the laws of combination of these symbols are nearly the same in all, because the things signified, whether material objects or mental operations, are nearly the same in all. One nation may have *more* words or symbols than another because it is acquainted with *more* external objects, or has more ideas; but those which are common to all are combined according to the same laws. And, as in algebra, so the use of a word or symbol to denote a particular object, leads to generalization, or

else is the result of generalization. A child sees a particular tree, an oak for instance; he hears the word "tree" applied to it (or *sees* the printed word so applied); on seeing an elm and hearing the same word applied to it, and so on, he acquires the use of the symbol or word "tree," as a *general term.* If now he learns any of the properties of the oak, as for example, the relative position of its bark, pith, roots, &c., he will describe these as the properties of "a tree." But it is needless to pursue any farther this point of similarity between common and algebraic language.

Another point of resemblance, however, may be worth adverting to. Many words are used in two or more different senses—the word "seeing," for example, which sometimes denotes a physical and sometimes a purely mental operation. Take now some proposition in which this symbol, or word "seeing," occurs; and supposing for the moment that we do not *know* whether it is true of the physical meaning alone, or of the mental meaning alone—we may ask whether it is not true for *both.* Does not every one perceive the similarity of such a proposition (or *common language formula*) to those algebraic formulæ which are true for different significations of the symbol, or symbols they contain?

Now, suppose we did not *know* beforehand that such a proposition *is* true for any signification of the word "seeing," except its physical one—in order to convince ourselves whether any other meaning is admissible, we should of course examine the proposition itself and endeavour to gain distinct notions of the fundamental conceptions and suppositions from which it was obtained. If these are found to involve nothing which is not equally true of the other sense of the word, of course the conclusion is obvious, that the proposition is equally true for this other sense. The general question, indeed, "How far, can we extend properties, proved for one (physical) meaning of a word, to the other (mental) or metaphysical meaning?" is of precisely the same kind as the mathematical question—"Under what restrictions, or by what alterations of interpretation of the symbols, can a theorem proved for one set of meanings be extended to another set of different meanings?"

To carry out fully this comparison between common language and algebraic language would be one of the most interesting and valuable undertakings that I know of, but would require a greater union of metaphysical ability and mathematical acquirement than is often found in the same person. The recent Logical Essays by Mr. Boole and Professor De Morgan are intimately connected with this subject, and we may perhaps hope that they will be induced to investigate the subject under its most general aspect, and in a form adapted to exhibit its importance to mathematicians.

Before concluding these few hints, it will be well perhaps to consider more particularly and fully than has been done in the preceding pages, the following *practical* question, (I use the word practical for want of a more appropriate one, meaning thereby that the question refers to no merely speculative views or methods of extending the science, but actually occurs to every student of even elementary mathematics and on the answer to which it depends, whether his studies are to be intellectual or merely mechanical exercises, in short, whether he is to understand what he is reading and be convinced by satisfactory reasoning, or consider it all juggling and very *un*satisfactory). The question may be stated thus—"How can there be any satisfactory reasoning in a process containing symbols which indicate *impossible* operations?" Every student will recognise at once what is here alluded to. The symbols $\sqrt{-1}$, $\varepsilon^{\theta\sqrt{-1}}$, are totally unintelligible or impossible in an arithmetical sense. And yet, arithmetical results are got by means of them! Every student who reflects at all, naturally asks, "can such results, so obtained, be depended upon as *true?*" And when this first question is answered in the affirmative, by reference to other methods which corroborate these results, the next inquiry is, "What *is* the reasoning, thus symbolically expressed, which leads to these results?" For, it appears as strange to arrive at arithmetical truths, by means of non-arithmetical symbols, as if a truth in political economy were obtained as the result of an argumentative process, some steps in which had no meaning except a geometrical one. In such processes the reasoning goes on clearly up to a

certain point—and then we lose all sight of it for a time, till at last it emerges again as distinct as before; like the course of a boat on certain romantic rivers, which suddenly disappears in some mysterious cavern, and as suddenly comes to light again in a distant place, having undergone no one knows what; or to use a less poetical illustration, like the rough material put into one of those wonderful machines which ingenious moderns have made as ingenious as themselves, and which after passing through unknown operations, comes out a completely fashioned and perfect work of art. But the invisible agency of the hidden mechanism and the dark windings of the mysterious cavern, may be exploded and understood—and so may the whole course of the reasoning as carried on by the agency of symbols.

The explanation of the difficulty is, in fact, contained in the considerations brought forward in the previous pages—but perhaps not so explicitly as to render needless the re-statement of the principle in a concise form, and a detailed examination of a particular case in the elementary part of mathematics wherein it is involved; to both of which I next proceed.

(*To be concluded in our next.*)

MEMOIR OF JOHN BUTTERWORTH, OF HAGGATE, NEAR OLDHAM.*

John Butterworth was born at Haggate, more commonly called Royton-lane, near Oldham, in Lancashire, on the 16th of February, 1774. He was the son of John and Ann Butterworth, of the same place, and was the eldest of a numerous family. His father being a weaver of fustians, and in very humble circumstances, was consequently unable to procure much instruction for his family: young Butterworth, however, was sent to a *dame's* school when three or four years of age, and subsequently a month or two to a free school in the neighbourhood. Before he had learned to read, the necessities of the family became urgent, and he was sent at six years of age to work at a Dutch wheel in the neighbouring village of Royton, by which he was able to earn about 1s. 4d. per week. He was afterwards employed in winding bobbins for the use of the weavers, and at ten years of age he commenced his father's employment of weaving; at which he continued the greater part of his life. About this time he had the misfortune by some accident to set fire to a collier's wooden cot, which is usually erected at the mouth of the coal mine to protect the banksman from the weather; he was so alarmed at the circumstance that he "ran away" towards Colne, where he wandered about about for a couple of days, but without finding any friendly roof to give him shelter. This was the only time he *was ever absent from home, even for so short a period;* on another occasion he is said to have spent an evening in Saddleworth; and these are the only instances of Mr. Butterworth's "*absenteeism*" which can be remembered. So great indeed was his love of home that he resided for *fifty-five* years in the *same* house, and it was frequently his boast that he had "never *slept* a night out of Royton-lane in his life:"—even the modern "rail" had no attraction for him, and he died without having ever seen any one of King Hudson's "iron belts." It was not until the age of twenty that he became able to read and write tolerably, he and some of his companions having instructed themselves after the conclusion of their usual employment. A stray copy of one of the *Diaries* first turned his attention to mathematics, and having associated with some persons in the neighbourhood who were fond of *geometry*, Butterworth soon began to give evidence of his rapid progress in his ever afterwards favourite study. Dr. Hutton s *Miscellanea Mathematica* now fell into his hands, being the first work he *ever purchased* on the subject of mathematics; this publication inspired him with a desire to become a contributor to such works, and having joined a "mathematical club" which was then in existence at Oldham, and of which the late Mr. Wolfenden was also a member, he so far profited by the advantages of the society as soon to be enabled to answer most of the geometrical questions proposed in the periodicals of the time. In most parts of the northern counties the works of Sir Issac Newton are looked up to with a species of reverence and ambition not easily described, and a copy is generally purchased with the greatest eagerness. The *Principia* was not only procured, but carefully studied by Mr.

* Furnished by our esteemed correspondent Mr. Wilkinson, in answer to the enquiry of "Contributor." *Ante*, p. 297. ED. M. M.

Butterworth; with some of the profounder parts he was known to be well acquainted, and a glance at his numerous and elegant solutions in various periodicals will show that he was deeply versed in the writings of most of the ancient geometers. But though the geometry of the Greeks may be said to have been his principal delight, and though the imperishable writings of the Glasgow and Woolwich Professors, the Translations of Lawson, and other similar works were, comparatively speaking, almost as dear to him as the "big Ha' Bible" to the Scotch, *this* was by no means the *only* subject in which he excelled. The pages of the *Mathematical Companion*, in particular, will abundantly prove that he was well read in the Fluxional Calculus and its applications. With spherical geometry too he was intimately acquainted, and frequently shared the honours of demonstration with Lowry and Howard. Some of his earliest productions appear in the *Student*,—to which work he was a constant contributor from its commencement in 1797, to its close. He also furnished three of the last propositions in the editor's well-known "Modern Geometry." His name is also of frequent occurrence in the *Mathematical Repository*, the *Enquirer*, the *Leeds Correspondent*, and more recently in the *Northumbrian Mirror*, and *York Courant*. He appears in the *Ladies' Diary* for 1816, and in the *Gentleman's Diary* for 1819—20; but for some reason or other his contributions to these periodicals were discontinued until the year 1837. Mr. Butterworth's favourite publication was the *Gentleman's Mathematical Companion*. To this work he devoted the greatest portion of his leisure for upwards of twenty years. His first contribution was printed in the number for 1801, and already proved him a geometer of no mean abilities. His subsequent correspondence exhibits a course of profound and elegant research; many valuable theorems have resulted from his labours, and so much were his papers valued by the conductors of that work, that the copy has frequently been detained from the press in order to give time for Mr. Butterworth to complete the writing out of his investigations. Many well-earned prizes served as a stimulus to still greater exertions, and altogether his mathematical career, for brilliancy, originality, and extent, can only be compared with those of Lowry, Cunliffe, Whitby, and Swale. Besides the solutions which appear under his real name, he furnished numerous others to less gifted aspirers, who were frequently unscrupulous enough to pass them off for their own. Indeed, in some publications, "questions and answers" can be pointed out "by the dozen," which while they serve in some degree to elevate certain names *now* altogether "unknown to science," belong *in reality* to Mr. Butterworth, and he often regretted that *his necessities* sometimes compelled him thus to "enable others in some measure to *deceive* the public, by claiming for themselves a knowledge which they did not possess." As Mr. Butterworth was never married, he followed the occupation of hand-loom weaving, and continued to reside with his mother until her death in 1837; his father having died some years previously. About this time steam power had almost superseded the hand-loom, and in consequence of indifferent health and the very low wages paid for this kind of labour, he relinquished the use of the shuttle and commenced a small day-school in his own house, but as might be expected with no great success. Mr. Binney, of Manchester, paid him a visit in December, 1843, and after "a world of trouble" succeeded in finding him out by the local *sobriquet* of "Ow'd Jack o' Bens;" his school *then* consisted of twelve scholars, whose wages amounted to 2s. 10d. weekly; he also sold sweetmeats and several other trifling articles, and this, with now and then a trifle for private lessons to mechanics and others, together with occasional assistance from his kind friends, Professor Hodgkinson and Mr. Henry Buckley, of Woodhouse, Delph, constituted the total income of "this nobleman of nature." Being of very simple habits, his wants were consequently few; yet even these were not always promptly supplied. For some years previously to his death, he was obliged to return *all* letters addressed to him on account of the extra expense for delivery, and on one occasion "stern necessity" compelled him to dispose of a portion of his books for the small sum of 2*l.*;—this, *to him*, would have been a severe privation had not the purchaser kindly allowed him to peruse them whenever he had occasion. In 1843 his health rapidly declined; — a disease of the lungs almost continually harassed him

with distressing fits of coughing; and being now near 70 years of age, it was impossible for him any longer to endeavour to support himself. His case was considered so deserving that three of his most intimate friends, Mr. Buckley, of Delph; Mr. Heap, of Royton; and Mr. Ogden, of Shaw, determined to bring it before the public, and for this purpose addressed a memorial on his behalf to Eaton Hodgkinson, Esq., of Manchester. This worthy gentleman took the subject up with his usual liberal spirit; and the result was, that a circular was issued by Messrs. Moore, Hodgkinson, and Binney, convening a public meeting, which was held in the Town Hall on the 8th of December, 1843, and which was attended by the Rev. Canon Parkinson, the mayor (chairman); Alderman Kershaw; James Heywood, Esq., F.R.S.; Capt. Brown; Messrs. Moore, Hodgkinson, Binney, Crossley, Lingard, &c., &c., and other influential gentlemen of the town and neighbourhood. The cases of John Butterworth and James Crowther, the noted botanist, were brought prominently before the meeting by Messrs. Binney and Hodgkinson, the former of whom had visited them expressly. He furnished a short sketch of their lives and labours, which has formed the groundwork of the present notice; and at the close of the meeting a society was formed, entitled "The Manchester Scientific Fund Society," whose object was the relief of scientific persons in humble life. During the last two years of his life, Mr. Butterworth received from this society the sum of five shillings weekly; "and this," says one of his friends, "with frugality and care, enabled him to live tolerably comfortable." He died on the 3rd of December, 1845, in the 71st year of his age, leaving, *by will* bearing date on the 2nd of December, the whole of his furniture to his surviving sister, and his books to his nephew, Joseph. His personal appearance was very prepossessing, and being much inclined to corpulency, this circumstance somewhat increased his antipathy to travel. "He is a fine, stout old man," says Mr. Binney, "having an extraordinary massy head, covered with snow-white hair, and a countenance beaming with intelligence and good nature. His manners are simple and very pleasing." In private life, his character was without a stain;—loving all, and doing good, he was in return beloved by all who had the pleasure of his acquaintance, and, as the gentleman above quoted well observes, "whether we consider his duties to his parents or to his neighbours during his long life, there is but one opinion—*that he has been a most worthy, sober, and upright man.*" His portrait, taken after death, and which is considered an excellent likeness, is now in the possession of Mr. Buckley. His remains were interred in Royton Church-yard; Mr. Hodgkinson, and many others, following them to the grave. The spot where he rests is marked by a plain stone, bearing the following inscription:—

"In memory of John Butterworth, of Haggate, Royton, who died December 3rd, 1845, aged 71 years.

"Though in humble life, he by self-instruction obtained a profound acquaintance with the mathematics.

"His numerous contributions to the leading mathematical journals during half a century, on the various branches of the ancient geometry, gained him a high reputation, and increased in this neighbourhood an ardent love of that sublime study; whilst his unaffected simplicity of manners and his blameless life commanded the esteem of all who knew him.

"This simple tribute of respect is inscribed at the instance of a few members of the Literary and Philosophical Society of Manchester, and others, in the hope that future votaries to the sciences may be stimulated and encouraged by his honourable example."

His friends and admirers have also erected a tablet inside the church, which bears the following appropriate inscription:—

"In memory of John Butterworth, of Haggate, Royton, who died December 3rd, 1845, aged 71 years.

"Though of humble birth and limited means, he nevertheless obtained a distinguished place in the Temple of Science.

"His abilities, upright conduct, meekness of disposition, and unassuming manners, gained for him that esteem so justly due to modest worth."

For many of the most important

facts in the preceding notice, I am indebted to the kindness of Mr. Henry Buckley, who promptly furnished me with many important documents relating to Mr. Butterworth's life. It will be seen from what is here stated, that "Contributor" (whose statement appears in No. 1311, of this Journal) must have been misinformed. I am, Sir, &c.,

THOS. WILKINSON.

Burnley, Lancashire, Oct. 9, 1848.

[Mistakes, strange as it may seem, often lead to truth. Our valued correspondent, who signs himself "Contributor," has managed to make a couple at once—the first, however, which in twenty long years we have known him make. The circumstances attendant on Murphy's career have led to a complete proof that an "ungrateful public" had nothing to do with the fate of that "son of genius." Of him we would say, with the elegiac poet—

"No further seek his merits to disclose,
Or drag his frailties from their dread abode;
There they alike in trembling hope repose—
The bosom of his Father and his God!"

We would point to the *moral lesson* conveyed in Murphy's history, and which is so emphatically and forcibly expressed by our correspondent, "Y. K. W."—"*take care to provide mental relaxation as well as mental occupation.*" A man may have "too many irons in the fire;" but, on the other hand, he may have too few. He is more likely to burn his fingers with one than with half-a-dozen. We have known mathematicians seek relaxation in a *fiddle*, in a *painter's brush*, in *mechanism*, in *ethnology*, *theology* even, and in *scribbling for the newspapers*. We have known, indeed, men of the most serious and devout pursuits who have amused their leisure with the most frivolous things. Such even are wise men; for it is not in human nature not to break down under the continued pressure of a *single study*.

Our friendly "Contributor," by referring to Butterworth—a fond name of our younger days—has led Mr. Wilkinson to take advantage of the means afforded by contiguity of position, and his friendships in his locality, to seek out the facts of Mr. Butterworth's life from the most authentic sources. He has also sent us the authenticating documents, so that we feel quite certain of his accuracy.

In Butterworth's case we see the same principle which "Y. K. W." has enforced. With Butterworth, his work was the loom; his recreation mathematics! Talk of the "pursuit of knowledge under difficulties," and look at the great geometer, Butterworth! —ay, and twenty—fifty others whom we could name, and some of whom we shall hereafter name. *Comparatively*, the men who rise now—"who rise by pure force of talent, and live by their heads in later, as by their hands in earlier life"—have infinitely much greater advantages than those who so rose forty years ago. Of this, however, more hereafter. ED. M. M.]

APPLICATION OF GUTTA PERCHA TO ELECTRO TELEGRAPHIC PURPOSES. — MR. HAMMERTON IN REPLY TO MR. WISHAW, MR. BADDELEY, ETC.

Sir,—My letter on the improved insulation of telegraphic wires, published in page 1310 of the *Mechanics' Magazine*, has led to no less than three replies in the following number.

The first is from Mr. Wishaw, who states, on the part of the Gutta Percha Company, that he exhibited at the late meeting of the British Association specimens of wire covered with small tubes of gutta percha. Doubtless, this was the case; but the wires on which I experimented were covered by the Gutta Percha Company for me, and upon the plan I suggested, some months *before* the meeting of the British Association. Mr. Wishaw is the engineer of the Gutta Percha Company.

With reference to Mr. Baddeley's remarks, I shall only observe, that Mr. Alexander Bain, who was one of the Directors of the Electric Telegraph Company, gave me his valuable aid in testing the efficiency of the gutta percha-covered wires, and declared himself highly satisfied with the result of the experiment, observing at the time, that he thought he could apply them advantageously in some projects in which he was then engaged. If that gentleman were in England, I am sure he would bear me out in these remarks.

I must beg to correct the statement of "Z.U." "that in February last, gutta percha tubes of the same shape and length were used in Kilsby Tunnel, North Western Railway, partly at the suggestion of Mr. Physick, the Telegraph Company's engineer." Wire covered with India-rubber was put up in the Kilsby Tunnel, and subsequently a covering of gutta percha was added at the points of suspension, to prevent the India-rubber being destroyed by the friction of the wires; but not until long after February. No one knows better than "Z. U." that Mr. Physick and I had had several conversations on this very mode of insulation, long before it was put into practice. As early as the beginning of January, I suggested to one of the Directors of the Electric Telegraph Company the use of India-rubber or gutta percha as a means of improving the very defective insu-

tation of the telegraph wires on the South-Western line.

It is gratifying to observe that no one doubts the soundness of principle in the use of gutta percha for the purpose of insulation, though so many lay claim to the discovery.

I am, Sir, yours, &c.,
J. H. HAMMERTON.

Brixton, October 3, 1848.

THE PLANET NEPTUNE. M. LE VERRIER'S EXPLANATION.

(From the *Comptes Rendus*, as translated in the *Athenæum*.)

It is two years since I discovered the planet Neptune by means of the perturbations produced by it in the motions of Uranus. My earnest solicitations that my labours should be verified by means of a telescope were listened to at Berlin; and on the 23rd of September, 1846, was begun, in the Prussian Observatory, the regular series of observations of Neptune.

I had only arrived at the position of this planet by indirect means, and without having seen it. It was, therefore, impossible that I should have attained as much precision as the direct observations of the star itself would afterwards insure. Since it was necessary that I should make use of irregularities, on which I could only depend to within *a tenth* of their value (as I will hereafter explain, if desired), it would have been natural that this inaccuracy should influence the positions thence deduced for Neptune, and that these positions should be liable to an error of one-tenth. But I shall make it appear that the deviation from my theory is far inferior to this tenth. Hence it will naturally result that all assertions to the contrary are false. Without troubling myself more than necessary with the clamour attempted to be raised on this subject, I think it nevertheless my duty to take due notice of it; for if such an error should *for a time* take the place of truth, it would not fail to discourage deeply all those devoted to the progress of science.

"The identity of the planet Neptune with the theoretic planet," says M. Babinet, in his notice of the 21st of August last, "is no longer admitted by any one, after the enormous difference discovered between them as to mass, period of revolution, distance from the sun, eccentricity, and even as to longitude (except at the epoch of the discovery of M. Galle, or for a very few years before and after.") If I quote this observation by the learned physicist, it is only because it sums up with infinite care all the pretended difficulties. I will go over each in particular, and reduce them successively to their real value. But I shall be permitted not to find a difficulty in the gratuitous assertion that "the identity is no longer admitted by any one." I say that after this discussion, no one will hesitate respecting the assertion of M. Babinet (*Personne ne s'arrêtera au dire de M. Babinet.*)

Let us first fix precisely the state of the question. I have determined the position of Neptune by means of the perturbations which it produces on Uranus. Accordingly, when such perturbations take place, I can find directly where Neptune is. But when there are no perturbations, this is impossible. Let this not be forgotten. Again, the action of one planet on another depends, at a given moment, only on its relative situation in the heavens and on its mass. The only facts, therefore, which I could conclude from the perturbations of Uranus, while they existed, were the direction in which Neptune was to be found, its distance from the Sun, and its mass. Let us see how I have arrived at the determination of these three quantities.

First. It is true that the direction in which I have placed Neptune contains an enormous error, except for the epoch of M. Galle's discovery, or for very few years before and after? No; this is false. I place before the Academy of Sciences a chart of the respective situations of Neptune, in the orbit I have theoretically assigned to it and in the orbit resulting from direct observation. The latter positions have been taken from Mr. Walker, so as to avoid all suspicion of my having attempted to obtain a smaller deviation. According to this figure, the following are the minimum deviations from my theory:

In 1857 + 4°·0
1847 + 1·0
1837 − 0·7
1827 − 2·0
1817 − 3·1
1807 − 4·5
1797 − 6·8

It follows that *during sixty-five years*, my theory, deduced from indirect considerations, assigns to Neptune a series of positions never differing from those obtained by the direct orbit by more than *one fifty-fifth*, at the most, of the circumference of a circle. And this is called a small number of years, when it is known that Neptune has had a sensible effect on Uranus for only twenty-five or thirty years at the utmost! The *fifty-fifth part* of the circle! This is what is called an enormous error, when it is known that the data which served as basis to my theory are only known to *a tenth*. But I do not insist on this subject, as I hear M. Babinet declare, that when he spoke of *enormous errors*, he had not calculated them, and imagined them much more considerable than they are in reality. But, it will be said, if we go beyond these sixty-five years, we should find more considerable deviations. Yes, without doubt. That results from the nature of the question; it cannot be avoided. I have said that I determine the position of Neptune by means of the perturbations it produces on Uranus. When there are perturbations, I can say where Neptune shall be found: but to ask me to do so, long after the perturbing action has disappeared, is simply to ask an impossibility—a sort of miracle. Now, in examining my plate—which in a few days I shall place before the public, and in which I have traced the course of Uranus—It appears clearly that this planet has been influenced by the action of Neptune only from 1812 till 1842,—that is, during only thirty years.

It is then during these thirty years only that I have been able to determine directly the position of Neptune; and yet the deviation from my theory is only 3°·7 in 1812, at the time when the action of Neptune, which then only commences, was not yet clearly determined. Then, in proportion as this action developes itself, the precision of my indications increases; and in 1842, at length, when I have at my disposal all the action of the planet, I am mistaken by no more than a fifth of a degree only—that is, by an 1,800th part of the circumference—in predicting the direction in which Neptune should be seen.

Thus, far from reproaching my theory with having made the trifling error of 4°.0 in 1807 and of 6°·6 in 1797, it should rather be asked how it could give with such precision the position of Neptune at an epoch when it did not act upon Uranus? In fact, this is only obtained by prolonging arbitrarily the curve which I had obtained from 1812 to 1842; a prolongation with which my object had nothing to do (*qui n'est pas de mon fait*) and which is not legitimate when pushed too far. During these thirty years Neptune has performed only a sixth part of its orbit: an ellipse is very ill determined by an arc including only a sixth part of its extent.

During the whole of the last century, from 1700 to 1812, Neptune had in nowise acted upon Uranus. It has had less influence on it than on Saturn,—which it does not sensibly disturb. When I am required to say, by my theory, where Neptune was in the middle or at the commencement of the last century, I repeat it, a miracle is demanded of me.

I have then the right to say—It is false that I have committed an enormous error in the longitude at every other epoch but that of Galle's discovery or of a few years before and after. During the whole period that Neptune has acted upon Uranus my theory has not deviated from that deduced from direct observations by more than 1·91 of the circumference. And now it is said the discovery made by Galle is a fortuitous accident! Really, then, planets of twice the size of Uranus and yet unknown, although shining like stars of the seventh magnitude, are scattered in such numbers over the heavens that there is nothing surprising if, on pointing by chance to any spot in the firmament there should be great probability of finding one! And it is, no doubt, on account of their numbers, and because there would be no merit in discovering them, that our observers disdain to do so.

Secondly,—*Is it true that there are enormous errors respecting the distance from the Sun? NO; this is false.* Figures have their eloquence. Here are, according to my plate, the distances from the Sun in the two orbits for the thirty years during which Neptune has acted upon Uranus:

	Distance in the predicted orbit.	In Walker's orbit after the discovery.
In 1812	32·7	30·4
1822	32·3	30·3
1832	32·6	30·2
1842	32·8	30·1

How is the difference of the two theories to be estimated? In reference to the distance itself which is to be valued? Whoever, in order to strike the imagination of the public, should express this difference in post-leagues, that is, in referring it to the slowness with which we crawl upon the surface of our globe, would be following a proceeding unworthy of an astronomer. Now, in 1812, I have made an error of 1·14th of the distance, in 1822 and 1832 1·16th, and in 1842 1·13th; never the *tenth* which I might have reached without being liable to any reproaches.

The direction was more precise than the distance. This might be,—for if the direction had been false nothing could have compensated for the error which would have resulted in the attraction of Neptune upon Uranus. Whilst, if the planet be placed a little too far in a given direction, the error, which would result in the quantity of attraction, may be immediately destroyed by making the planet a little larger. This is precisely what has taken place. I placed Neptune rather too far; but I made it rather too large. I might have placed it in any intermediate place, even a little too near, provided I had made it a little too small. But what am I saying? I have made Neptune too large! I forgot that this is a third objection. Let us examine it, however. Thirdly,—*Is it true that the theoretic mass of Neptune differs from the mass deduced from observations of the satellite to such a degree as to be an irresistible argument against the identity of the theoretic Neptune with the observed Neptune?* No; *this is false.* Let us again have recourse to figures. According to M. Struve the mass deduced from the satellite is 65·100 of the mass I had predicted. But I will grant, if it is insisted on, that 52·100 must be taken; which, however, is only arrived at by choosing from among the different results obtained that which leads to the greatest deviation. I declare that if any one should be misled by this deduction, which corresponds only to a variation of a fifth in the diameter of Neptune, it would only be by keeping out of sight the difficulties of the same kind presented by the masses of the other planets. The mass of Uranus has been also determined by two different methods—by the action of this planet upon Saturn, and by the consideration of its satellites. Well, the second of the values thus determined is only 75·100 of the first. And yet there were forty years of direct observation of Uranus at disposal whilst I had not a single observation of Neptune. And yet the mass only of Uranus was required to be deduced from its perturbations on Saturn, whilst I sought, from those of Neptune on Uranus, the direction, the distance, and the mass of the planet. Will it be said then that there are two planets Uranus? It should, to be consistent. Thus, then, the direction, the distance from the Sun, the mass of Neptune—that is to say, the only three things which might justly be required—are exact in my theory beyond all hope. The Neptune which has been found, like that which I sought, satisfies perfectly the perturbations of Uranus. This great accusation, which has made so much noise, falls back into that nothingness from which it ought never to have emerged. I might stop here. I shall conclude by considering the distance of the Sun from the Earth,—which has cost astronomers so much labour, so many journeys, dangers, and almost martyrdom. The measurement of this fundamental element of our system has presented, in the hands of the greatest astronomers, discordances greater than those objected to me. It may be obtained in two ways—by means of Mars or of the transits of Venus across the Sun. The first method is less precise than the second; but in return it may be repeated as often as desired, while the second can be employed only twice in about 120 years. Mars was the first employed in 1750 by Lacaille and by other astronomers of vast merit. They never found by this means more than 32,271,000 post leagues for the distance of the Earth from the Sun. And the agreement of the results obtained by repeated measurements gave perfect confidence in this number. Now, when the transit of Venus across the Sun occurred in 1769, a distance of 38,416,000 post leagues was obtained by means of this transit. The difference of the two results, 6,145,000 leagues, is simply the fifth part of the former. I will add that the difficulty is not completely resolved at present. I have never had a similar difference. Should it not be admitted, then, for the sake of consistency, that there are two Suns, as there are to be two Neptunes—the Sun of Mars and that of Venus?

LIGHTING BY ELECTRICITY.

A very interesting lecture on the Physical Properties of Light was delivered by J. H. Pepper, Esq., on Thursday evening, at the re-opening of the Western Literary and Scientific Institution under new auspices. Should all the lectures be as ably given as this, we cannot be mistaken in anticipating great success to the institution. The lecturer after alluding to, and illustrating the different means by which light could be obtained, and the various theories and laws governing its production, drew the attention of his auditory to the electric light. He said that electricity had been long known as a most powerful agent for the production of light, but that the obstacles to its employment for illuminating purposes, consisting chiefly in the inability to procure a sustained and steady light, had hitherto been thought insurmountable. He, however, had the satisfaction of exhibiting an electric light apparatus invented by Messrs. Staite and Petrie, in which every difficulty had been overcome. The lecturer then put the apparatus in connection with the wires of a galvanic battery, and immediately a beautifully pure and intense white light was produced, completely eclipsing the ten gas lights with which the hall was lighted, as also an oxyhydrogen light. The paper shade was removed from the apparatus, and the light intercepted by a glass prism, showed the purple and violet rays in great perfection. We shall lay before our readers a full description of Messrs. Staite and Petrie's last improvements shortly after the enrolment of their specification in January next.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Elias Robison Handcock, of 16, Regent-street, London, and Rathmoyle House, Queen's County, Ireland, Esq., for certain improvements in mechanism applicable to impelling and facilitating the propulsion of vessels in the water, which improvements are applicable to locomotive engines for railways and other similar purposes. October 12; six months.

John Ashby, of Carshalton, Surrey, miller, for certain improvements in machinery applicable to cleaning grain and dressing meal. October 12; six months.

Daniel Watney, of Wandsworth, Surrey, distiller, and John James Wentworth, of the same place, for improvements in machinery for drilling metals and other substances. October 12; six months.

John Wright, of Camberwell, Surrey, engineer, for improvements in generating steam and evaporating fluids. October 12; six months.

Charles de Bergue, of Arthur-street, West, City of London, engineer, for improvements in bridges, girders, and beams. October 12; six months.

Arthur Dunn, of Dalston, chemist, for improvements in ascertaining and indicating the temperature and pressure of fluids. October 12; six months.

John Davie Morris Sterling, of Black Grange, N. B., Esq., for improvements in the manufacture of iron and metallic compounds. October 12; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Oct. 6	1604	John Coney	Birmingham	Instrument for crochet and tambour work.
,,	1605	Henry M'Groy	Birmingham	Eye (hook and eye.)
,,	1606	Thomas Walley	Salford	Portable stamp and label affixer.
7	1607	H. Crosley, Son, and Galsworthy	Southwark, engineers	Gas exhauster.
,,	1608	Harrild and Sons	Great Distaff-lane, and Friday-street	Printing apparatus.
,,	1609	David Walsh	Glasgow	Fork for weft protector.
9	1610	Thomas Drew	Plymouth, Chemist	Sanitary belt and cholera repellant.
10	1611	Ralph Wedgwood	Rathbone-place and Lombard-street	Clip desk.
,,	1612	Robert Bedington	Birmingham	Knob for latches and catches.
,,	1613	E. M. Hanford	Hathern, near Loughborough	Double-acting draught tackle.
11	1614	Alfred Wilson	Percival-street, Clerkenwell	A pair of silent shears.
12	1615	Joseph Tyler and Son	Warwick-lane, Newgate-street	Water-closet valve.
,,	1616	Richard Brotherton	Preston	Railway safety signal telegraph.

CONTENTS OF THIS NUMBER.

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Edited by J. C. Robertson, 166, Fleet-street.

HENSON'S WATER AND FIRE-PROOF RAILWAY GOODS CARRIAGE.

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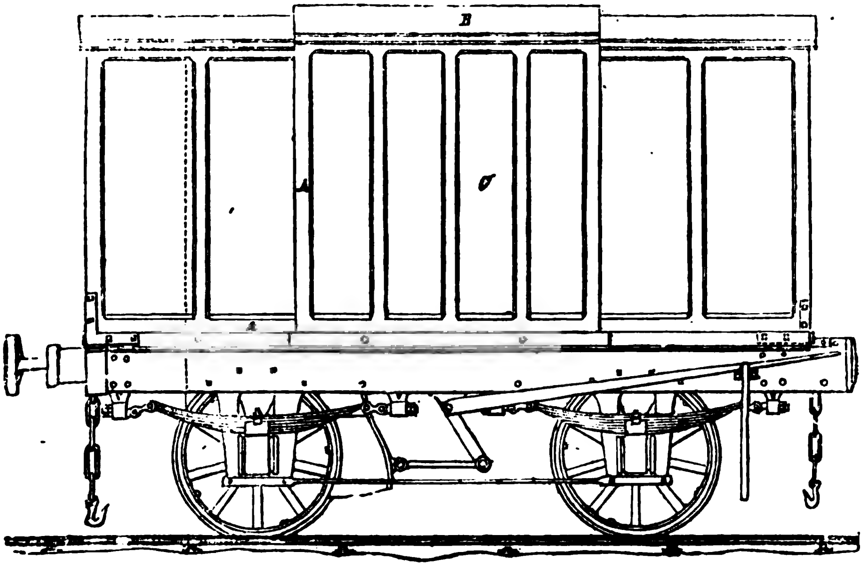

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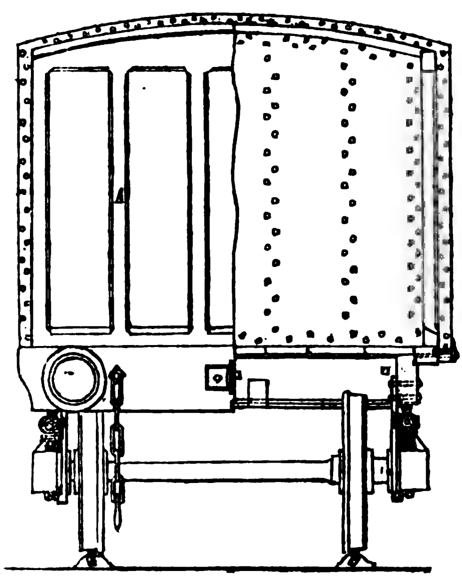


MR. HENSON'S PATENT "IMPROVEMENTS IN RAILWAY CARRIAGES AND WAGONS, AND IN VESSELS OF CAPACITY EMPLOYED IN THE STORING AND CONVEYANCE OF EXPLOSIVE SUBSTANCES."

[Patent dated April 15, 1848. Patentee, H. H. Henson, Hampstead. Specification enrolled October 14, 1848.]

The improvements embraced in Mr. Henson's present patent are classed under three separate heads: I. Improvements in wheels. II. In axles. III. In springs. IV. In goods' wagons. And, V. Vessels of capacity for the conveyance and storing of gunpowder and other combustible substances.

I. *Improvements in Wheels.*

These improvements are thirteen in number—not all capable of embodiment in any single wheel, but consisting rather of so many different and alternative modes of forming railway wheels.

1. The spokes of the wheels are proposed to be formed of bars of *rolled* iron, so shaped at their inner ends, that on being arranged in a circle and their ends welded together, the latter shall form the nave. These peculiarly shaped ends may consist either of separate rolled pieces welded to the spokes, or be originally formed in one with the spokes.

2. Out of one piece of rolled iron are to be formed part of the felloe and part of one of the spokes of the wheel.

3. From one piece also of rolled iron, part of the nave and part of one of the spokes are to be formed.

4. The nave, the spokes, and the felloe are to be formed of two pieces of rolled iron (such as 2 and 3) welded together.

5. The nave and portions of all the spokes are to be formed in one solid piece of iron.

Three several modes of effecting this are specified. Two of these, which are remarkable for their novelty, are thus described:

I form roughly, in the ordinary manner with a forge hammer, pieces of iron (either out of new iron or out of wrought iron scraps) into the circular shape with raised centre, shown in plan and section in figs. 1 and 2. I then place these pieces in dies of suitable form and size, and by hammering, give them a more perfect form and finish. The central hole for the axis at C, may be bored out of the solid, or it may be punched or cut out under the forge or other hammer to within a little of the finished dimensions, and afterwards bored to the finished size. The parts, *f f*, may then be heated and cut out, either by the smith or the forgeman, with chisels or cutters, or by a powerful steam or hydraulic pump or press; or they may be cut out without heating by means of a slotting machine. The nave and inner portions of the spokes having been thus completed, I then weld on to the ends of these inner portions of the spokes pieces of the part felloe and part spoke form, represented in figs. 3 and 4, which completes the wheel, in so far as regards all the central parts, namely the nave, the spokes, and the felloe.

Or, second, I take pieces of plate iron, of half an inch, or any other convenient thickness, and by a punching or other machine give them the shape shown in figs. 5 and 6. These pieces of plate iron are then piled together in the manner shown in the sectional view, fig. 7, and heated to a welding heat in a suitable furnace, after which they are placed in a die, such as that exhibited in plan at fig. 8, which serves the office of an anvil, on which they are welded by the action of the forge or other hammer into one solid mass. A top die, fig. 9, of corresponding form to the bottom one (fig. 8) is next used for the purpose of shaping the welded mass into the form represented by figs. 10 (plan) and 11 (section). And in order that the parts of the nave between the spokes may be more neatly formed and finished, I hammer the same by inserting between the spokes, suitable blocks of cast or wrought iron (removing these blocks, of course, after the operation has been performed). The hammering process is then completed by placing the whole between a pair of dies, as shown by the sectional view, fig. 12, after which matters are in a fit state for having the remaining portion of the spokes welded on as before described.

6. The ends of the spokes are inserted in two indented collars, and the spokes and collars then welded together.

7. The wheel is made of hammered or rolled plates of iron, and the plates forming the part between the spokes and the rim of the wheel are welded either to the outer rim or to the nave, or to both. Sometimes the rim and that part between the rim and the nave are made in one piece, and sometimes also, the two last-named parts are made in one piece with the nave.

8. The nave and a portion of each spoke are formed by hammering as above.

Fig. 1.

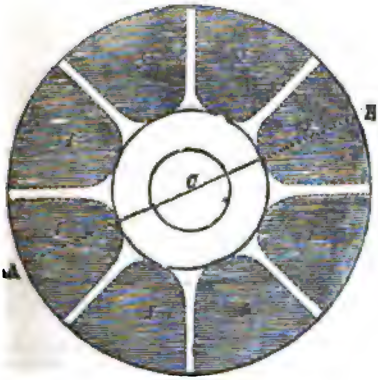


Fig. 2.

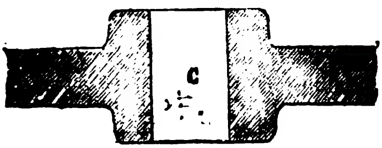


Fig. 3.

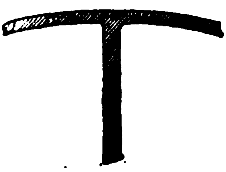


Fig. 4.

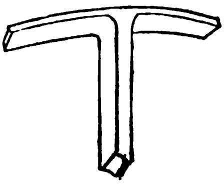


Fig. 6.

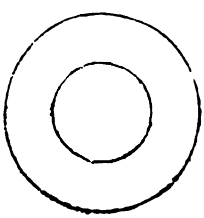


Fig. 5.

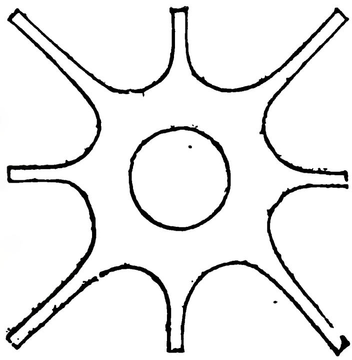


Fig. 7.

Fig. 8.

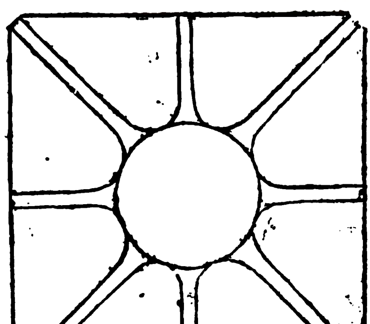


Fig. 11.

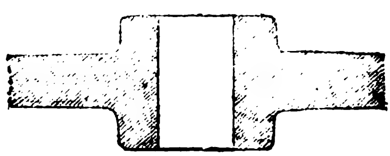


Fig. 9.

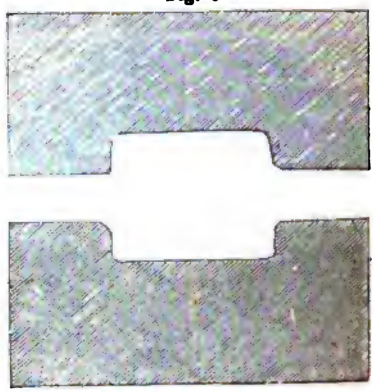


Fig. 10.

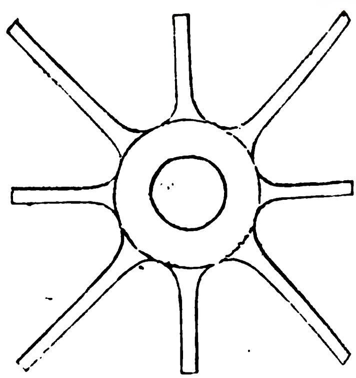
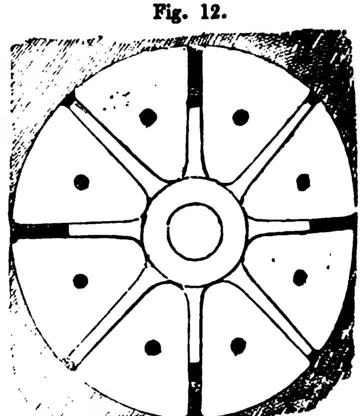


Fig. 12.



9. The nave is inserted into wooden wheels by means of a press, and the wooden segments forced out against the tyre.

10. The tyres of wheels are made of wrought iron or steel, bent and welded into continuous rings, and finished by hammering, so as to obviate the necessity of turning such tyres in a lathe. A very cleverly contrived machine for producing these tyres is described, but the patentee does not confine himself to the use of that alone.

11. The tyre is to be secured to the felloe or to the spokes, or to the rim and spokes, by projections formed either at intervals or continuously on the outside of the tyre.

12. The wheels are to be formed of a combination of iron and gutta percha, or any of the compounds of gutta percha suitable for the purpose.

The gutta percha is run in a melted state into a space between the felloe and tyre.

13. Wrought iron bosses are combined with tyres having internal flanches, and a peculiar method is described of fastening and welding such wrought iron bosses.

II. *Improvements in Axles.*

1. The axles of the wheels of railway carriages and wagons are proposed to be made of steel and wrought iron combined together in the following manner:

I first make a mould, the centre part of which consists of a hollow oblong piece of wrought iron and the outer parts of cast iron; and the former though placed within, is not otherwise united to the latter. I fill up the wrought iron centre-piece while it is in a welding state with cast steel in a fluent state, which permanently combines with the wrought iron casing. I then part the outer (or cast iron) halves of the mould, which leaves the inner part detached therefrom in the shape of what may be called a "compound steel and wrought iron ingot." I next roll or hammer this ingot into a segmental form. I then take a number of such segments and of suitable lengths, and arrange them together in concentric circles so as to form a fagot; a circular orifice being left in the centre to be filled up in manner to be presently explained. The fagot thus formed is held together by two hoops and exposed to the action of a suitable furnace till it attains a welding heat, when by passing it through rollers, or between suitable swages under a hammer, the whole of the wrought iron parts are soundly welded together without the cast steel inclosed within them, being at all exposed to the direct action of the fire. And of the fagot so composed, combined, and welded, I form the outer shell of the axle.

2. The axles are encased in wood in order to prevent or diminish vibration.

3. Auxiliary stay-rods are employed, which reach horizontally from one wheel to the other, for the purpose of keeping the wheels together in the event of any fracture of the axle.

4. The parts of the axles between the wheels are enclosed in cylinders, and the wheels stayed by diagonal rods connected to a central collar on the axis; for the purpose also of preventing vibration.

5. Long working bearings are used to enable the wheels to run loosely on their axles, which may either revolve or be fixed between the naves of the wheels.

6. Between the naves of the wheels and the axle, cushions of gutta percha, vulcanized India-rubber, or other like elastic substance, are inserted, in order to prevent vibration.

III.—*Improvements in Springs.*

1. A liquid is introduced into the cylinders of compressed air springs, to form a hydraulic joint or packing for the piston or ram to work through, and so to prevent the leakage of air from the cylinders, as before described.

2. Steel springs are employed in combination with elastic pistons working in a cylinder, and the employment of wrought iron cylinders in combination with buffer springs, both of which combinations are claimed as new.

3. An elastic air-proof diaphragm is introduced into cylinder springs, to prevent the leaking out of the air from the cylinder.

4. The springs are proposed to be made of bars of steel, of a girder section, with ribs or flanches.

5. For buffer bearers and draw-springs, Mr. Henson proposes to use spiral springs in the conical forms of diminishing spirals.

The construction of these springs is exceedingly ingenious, and in a future Number we shall give a full description of them, with engravings.

IV.—*Improvements in Goods Wagons.*

Mr. Henson introduces this branch of his improvements by the following reference to a former patent:

In the specification of former letters patent for England, granted to me on the 30th of August, 1846, for "certain improvements in railways and railway carriages, having for their object the better accommodation and security of the public," I described and claimed a mode of constructing the body parts of goods carriages of double panelings of iron, or iron and wood, and with sliding roofs, whereby the same are rendered fire and water proof, and may be as readily loaded and unloaded from the top, as open wagons. The plates of which these pannelings were composed were described as being attached to a framing of iron ribs, formed either by bolts, nuts, or rivets; and in the case of a combination of iron and wood being employed in the panelings, the iron was directed to be placed on the outside. The roof also was represented as being made in two parts, one of which was fixed, and the other moveable—the latter sliding lengthwise over the former.

1. The principal improvements in the arrangements now specified by Mr. Henson, are embodied in the goods wagon, two views of which are given on our first page. No. I., is a side elevation, and No. II., an end elevation, partly in section.

The framework, AA, is composed of wood indurated and rendered fireproof by Payne's process, or by any other known and approved means. *One* set of panels only is used, and these are attached to the inside *of* the framework by means of *screws*, as shown in the figures. The middle part of the roof, B, and the middle parts, CC, of the sides of the wagon are connected together and made to slide outwards towards either end.

2. Several other modifications in the mode of opening the sliding portions of the roof of goods wagons are described and claimed "in so far as the same have not been anticipated by the specification of the former letters patent granted to me and hereinbefore referred to."

3. Mr. Henson proposes to employ also for the covering of goods wagons sheets of gutta percha, or of any waterproofed textile fabric, or of any other flexible water proof substance or material capable of having a sheet form given to it, mounted on rollers or otherwise, so as to be drawn to and fro to any desired extent, over the top of the wagon.

4. Or, strips of iron overlapping one another and mounted so as to be rolled back at pleasure to any required extent (similar to the patent window shutters of Messrs. Bunnett and Corpe).

V. *Improvements in Vessels of Capacity for the Storing and Conveyance of Combustible Substances.*

1. Mr. Henson describes an improved

fire-proof wagon for the conveyance on railways of gunpowder and other combustible substances, the distinguishing peculiarity of which, consists in the body of the wagon containing inside a safety magazine insulated by water or carbonic acid gas.

2. A portable apparatus on the same plan as the preceding.

3. "To enable gunpowder and other such combustible substances to be withdrawn in small quantities at a time from the vessels in which they are stored, without taking off the lids or covers, and without any risk of sparks reaching to the bulk of the substance inside, I make use of an instrument of the following description, which is permanently attached to the bottom of the vessel. It consists of two concentric tubes fitting each other so closely that the interior one is just free to turn within the other, without any considerable friction; and this double tube is inserted into the vessel close to the bottom, but in a position slightly inclined upwards; care being taken to make the point of insertion perfectly air-tight. Both tubes have near to their outer and inner ends apertures of equal dimensions cut out of their peripheries. The outer tube is permanently fixed in the vessel, and its apertures are at top and bottom of the tube. The inner tube can be drawn out to nearly its full extent, (being prevented from being altogether withdrawn by a flange on its inner end,) and it may be turned so that its apertures shall either coincide with those of the outer tube or the reverse. When it is desired to withdraw from the vessel as much gunpowder or other combustible material as the inner tube will hold, it is turned round till the aperture at its inner end corresponds with the aperture at the inner end of the outer tube, when the gunpowder or other combustible material flows in and fills it. The tube is then turned back till the two apertures at the outer end of the tubes coincide, when a suitable receptacle being provided for the purpose, the contents of the inner tube flow out into it."

FORSYTH'S PATENT RAILWAY WHEELS.

[Patentee, Thomas Forsyth, New North-road, Engineer. Patent dated April 14, 1848; Specification enrolled October 14, 1848.]

Mr. Forsyth's improvements in the manufacture of railway wheels consist in rolling them by suitable machinery, out of circular discs of wrought iron containing the requisite quantity of metal, but of half the diameter and double the thickness of the intended wheel; or of rolling them out of thin circular discs of wrought iron, to which curved pieces of wrought iron have been welded, in order to obtain the required degree of thickness at the felloe and nave portions of the wheel. In the latter case the circular disc of wrought iron is of nearly the same diameter as that of the intended wheel.

The discs of wrought iron are first heated in furnaces near which the rolling machine is placed, and into which they are successively lifted by cranes. This machine consists of a framework which carries a vertical spindle passing through the centre and thereby supporting the disc. Opposite to, and at a convenient distance from that portion of framework carrying the spindle, is an upright shaft which gives rotary motion to two axles, mounted one above another, and inclined, the top one downwards, and the lower one upwards, so that the rolling cones which they carry at their other extremities are in close proximity. The purpose of these cones, between which part of the circular disc is caused to pass, is to roll that portion of the wheel which is between the felloe and the nave, and the distance between them may be regulated at pleasure by means of a toothed pinion and rack. Behind the vertical spindle are attached to the framework which carries it, two axles, which are inclined towards one another and furnished with rolling cones of smaller size than the other two, and placed one above the other, below the nave of the wheel. The office of these smaller cones is to make the nave surfaces of the disc, smooth and uniform. Around the disc, and fixed in the framework are placed, at convenient distances therefrom, several guide pulleys having indentations in their peripheries which serve to give the desired form to the tyre and flange of the wheel. The pressure of these guide pulleys against the edge of the disc, or tyre and flange of the wheel, is regulated by hand wheels.

GREEN AND NEWMAN'S PATENT METHOD OF ATTACHING TYRES TO RAILWAY WHEELS.

[Patentees, Charles Green and James Newman, Birmingham, manufacturers. Patent dated April 15, 1848; Specification enrolled October 14, 1848.]

The invention of Messrs. Green and Newman consists in a manner of attaching tyre bars to railway wheels. For this purpose the patentees employ a tyre bar bent into a step-like form, and having a small portion of the lower vertical point bent again at right angles, so as to serve for a catch or rest to the felloe of the wheel. This tyre is first laid in a die, and the wheel placed therein, so that the felloe part may rest upon the catch. The top vertical portion of the step-like tyre bar is then bent backwards by being submitted to the action of a series of top dies, until it lies along, and in close contact with the horizontal portion of the tyre bar, but projecting beyond it, when it is clenched down upon the felloe of the wheel, which is then held fast between it and the rest. In some cases it is clenched between the spokes of the wheel for the sake of greater security.

MADIGAN AND HADDAN'S PATENT RAILWAY WHEELS.

[Patentee, Richard Madigan, of Haverstock Hill, C.E., and John Cape Haddan, of Lincoln's-Inn-fields, C.E. Patent dated April 15, 1848. Specification enrolled October 14, 1848.]

The improvements of Messrs. Madigan and Haddan relate to three kinds of wheels—to those formed from discs of wrought iron, to those constructed with wrought iron spokes and naves, and to such as are manufactured of wrought and cast iron, or of cast iron alone.

The Wrought Iron Disc Wheels.

1. The patentees state that they prefer to employ sheets of wrought iron in which the grain of the metal does not run all in one direction, but radially from the centre of the disc, in order to diminish the risk of breakage, and that they effect this object by piling or fagoting the metal of which the sheet is composed, crosswise, and rolling it in different directions, until it is of the desired thickness.

From this sheet of wrought iron they punch or cut out a circular disc of larger diameter than the intended wheel—sufficient to allow of the formation of a rim or felloe to support the tyre.

2. To bend the circumference of this disc at right angles, so as to form the felloe, the patentees subject the heated disc to the action of a series of suitably formed dies, after which the tyre is attached to the felloe by shrinking, bolting, and riveting in the ordinary manner.

3. Or they forge, upset, or otherwise thicken the circumference of the disc to form the felloe.

4. Or, they fit the circumference of the disc into and against a ribbed tyre, or between a double ribbed tyre, after the manner patented by George Cottam, December 5, 1837.* The disc may in this case be straight or curved, or bent at an angle, and the tyre made to correspond, so that the two may fit exactly. The tyre and felloe are then welded and riveted together in the ordinary manner.

5. The nave is formed by making the disc, in the first instance, of the thickness of the nave, and then diminishing the whole of it in thickness by hammering, except the central part, which is to form the nave. Or, they form a recess in the centre of the disc on one side which produces a corresponding projection on the other side, and weld on bosses to form the nave, one into the recess, and the other to the projection. A third method given for forming the nave, consists in boring a hole in the wrought iron disc of larger diameter than that which is to serve for the axle, and cutting the disc radially for a short distance, then bending these radial portions of the disc in alternate directions, and finally casting the nave thereon in suitable moulds. It is also proposed to cast the nave upon one or both sides of the uncut disc, and to employ Perlbach's patent method of producing a perfect union between the surfaces of the wrought and cast iron.†

* Mr. Cottam's patent, dated December 5, 1837, was "For improvements in the construction of wheels for railway and other carriages." His invention consists in a mode of affixing the iron spokes to their rims or felloes by welding their outer ends to a flange, or between flanges, previously formed on the inner periphery of the felloe. After this, the tyre is shrunk on as usual. The patentee also describes, but does not claim, an apparatus for welding these wheels.

† For specification of Perlbach's invention, see *Mech. Mag.* vol. xlviii. p. 113.

Wheels with Wrought Iron Spokes and Naves.

1. The spokes are proposed to be welded alternately, first to one side of the wrought iron nave and then to the other, and afterwards welded to the T pieces, which form the inner rim or felloe for the support of the tyre; these pieces being first bent into an arc of a circle. These spokes may also be of an L form, or double L form, and welded to the nave and together, so as to form also the felloe, as in the case of the T spoke.

2. Holes are to be cut in the nave into which the spokes are welded, or the nave is to be formed of pieces of sheet iron, and these welded to the inner ends of the spokes.

3. The spokes, nave, and felloe, are to be formed out of rolled bar iron of the L or double L form. In this case the bars are first rolled out straight with projections at their ends and bent into the angular form, when on being arranged radially the inner ends of the bars with the projections thereon form the nave, and the remaining portions of the bars, the spokes and inner rim or felloe. The parts forming the nave are afterwards welded together; and in some cases a boss is welded on to one or both sides of the nave.*

4. The felloes of any of these wheels may be welded, united or bolted, or otherwise secured to a ribbed or a double ribbed tyre.

Wrought-iron Arm or Cast-iron Wheels.

1. The cast iron is proposed to be upon a disc in portable moulds, and Perlbach's process to be employed to produce a union between the two metals. The tyre is to be afterwards put on after the ordinary manner.

2. The body of the wheel is to be formed of cast iron entirely, by running the iron into the space encircled by the tyre, and causing it to adhere to the inside surface thereof.

ON THE PRINCIPLES OF ALGEBRA, AS A SYSTEM OF GENERAL REASONING; WITH A SKETCH OF ITS RECENT PROGRESS, AND A REFERENCE TO SOME RECENT PAPERS IN THE "MECHANICS' MAGAZINE."

(Concluded from page 348.)

It has been made clear, I trust, that algebraic theorems, equations, formulæ—(call them what you will, and for the sake of fixing the ideas, let the binomial theorem be taken as an example or type of such)—may be obtained simply by combining the symbols according to certain laws, the symbols themselves having no particular signification whatever. The process by which such unmeaning results are derived is in one sense a purely mechanical one—but, nevertheless, each step is a logical deduction from the preceding. (Refer to the extract from Dugald Stewart.) If there be now any signification assigned to these hitherto unmeaning symbols, according to the principles we have already seen to guide the selection of significations—(namely, that such meanings only are to be taken whose very nature renders the laws of combination used in forming the theorem *necessary laws*, *when* these said meanings are given to the symbols,) the theorem, which is *now* interpretable, expresses a *necessary* truth—the consequence of the very nature of the things signified. And, inasmuch as there are, or may be, many different things which when represented by these symbols, *necessitate* these said laws of combination, (on which, and on which alone, I repeat, the theorem is founded), the theorem may obviously express more than one truth—it may express as many, in fact, as there are different meanings admissible in the symbols. But, now, suppose we can find significations for *some* of the symbols used during the process, which make the laws of combination which have been used, necessary, but cannot find such significations for *all* the symbols—*how are we to interpret the result?* Why, we cannot interpret it all *if any of these unmeaning symbols occur in it.* But if the result itself

* This method is identical with that described under the 1st, 2nd, 3rd, and 4th heads of Mr. Henson's specification (see *ante* p. 386); but as both patents are dated on the same day, the right of Messrs. Madigan and Haddan to the invention is just as good as Mr. Henson's, and Mr. Henson's as good as theirs. The patent laws have made no provision for a case of conflicting title like this; and yet it is by no means one of rare occurrence.—ED. M. M.

is free from them, although they may have occurred in the process, the result is a necessary truth or proposition which may be translated into common language. If doubts occur as to the effect which the unmeaning symbols may possibly have had—if it be imagined that they have vitiated the chain of reasoning and rendered the result uncertain—let it be remembered that these symbols, although unknown or unmeaning, were subjected throughout to the same laws of combination as the other symbols—*and that the theorem or result depends only on these laws of combination.* If A is the same as B, and B is the same as C, and C is the same as D, I am certain that A is the same as D, although I may not have the slightest idea of what B and C, or even A and D *mean*. If I have to perform an operation O_1 on some subject, for which I am desirous of substituting another operation O_4 if I could be sure of its producing the same result, the nature of both these operations being fully understood, and I learn that O_1 is equivalent to O_2, and O_2 equivalent to O, and this again to O_4: I am satisfied that O_1 and O_4 *are* equivalent, even although perfectly ignorant of the nature of O_2 and O_3. There is not the slightest reason that we should be able to *interpret* O_2 and O_3 in order to be fully assured of the equivalence of O_1 and O_4. Nothing at all would be gained, indeed, in clearness of evidence by such interpretation. Let us now apply this to the examination of the proof that

$$2^{n-1}(\cos\theta)^n = \cos .n\theta + n.\cos(n-2)\theta + \frac{n(n-1)}{2}\cdot\cos(n-4)\theta + \&c.,$$

which may be found in any modern book on trigonometry: the substance being as follows:—

Denote, $\cos\theta + \sqrt{-1}.\sin\theta$ by the symbol x;

then since $(\cos\theta + \sqrt{-1}.\sin\theta)(\cos.\theta - \sqrt{-1}.\sin\theta) = \cos^2\theta + \sin^2\theta = 1,$

$$\therefore \cos\theta - \sqrt{-1}.\sin\theta = \frac{1}{x};$$

therefore adding and subtracting successively, we get

$$2\cos\theta = x + \frac{1}{x} \text{ and } 2\sqrt{-1}.\sin\theta = x - \frac{1}{x}.$$

And by Demoure's theorem, we know that

$$\cos n\theta + \sqrt{-1}.\sin n\theta = x^n$$

$$\cos n\theta - \sqrt{-1}.\sin n\theta = \frac{1}{x^n}.$$

$$\therefore 2\cos n\theta = x^n + \frac{1}{x^n}, \text{ and } 2\sqrt{-1}.\sin n\theta = x^n - \frac{1}{x^n}.$$

$$\text{Hence, } (2\cos\theta)^n = \left(x + \frac{1}{x}\right)^n = x^n + nx^{n-2} + \frac{n(n-1)}{1.2.}\cdot x^{n-4} + \&c.$$

$$= x^n + \frac{1}{x^n} + n\left(x^{n-2} + \frac{1}{x^{n-2}}\right) + \frac{n(n-1)}{1.2.}\left(x^{n-4} + \frac{1}{x^{n-4}}\right) + \&c.$$

and substituting $2\cos n\theta$ for

$$x^n + \frac{1}{x^n},$$

and so on, we get finally the equation above mentioned, by means of which $(\cos\theta)^n$ is expressed in terms of cosines of multiples of θ.

In this process we have the essentially non-arithmetical symbols $\sqrt{-1}$ and x. (for $2\cos\theta$ is represented by

$$x + \frac{1}{x},$$

and as $\cos\theta$ can never be greater than unity,

$$x + \frac{1}{x}$$

can never be greater than 2, and therefore x cannot be a *number* of any kind: the particular case of θ being zero,

although allowing of x having an arithmetical value, namely one, is here of no avail, as the equality is necessarily here a *general* one.) But in the result or final equation these are both got rid of. We have here, then, a necessary arithmetical truth obtained by a symbolical process, many steps of which do not admit of any arithmetical interpretation. Has the introduction of these unmeaning symbols vitiated the proof? Let us state the proof in common language, so far as that is possible, and its nature and conclusiveness will become manifest. The steps are as follow:

(1.) Cos θ and sin θ are supposed to have their usual meaning; then, whatever the symbols x and $\sqrt{-1}$ may signify, provided they are considered to be subject to the usual laws of combination of algebraic symbols—i. e. ordinary algebra:

if $\cos\theta + \sqrt{-1}\sin\theta$ be denoted by x

$\cos\theta - \sqrt{-1}\sin\theta$ *must* be denoted by $\frac{1}{x}$.

and $2\cos\theta$ by $x + \frac{1}{x}$.

(2). On the same suppositions, it is demonstrated in Demoivre's theorem, that

$$\cos n\theta + \sqrt{-1}\sin n\theta$$

is necessarily represented by x^n, and

$$\cos n\theta - \sqrt{-1}\sin n\theta$$

by

$$\frac{1}{x^n}.$$

and, therefore, $2\cos n\theta$ by

$$x^n + \frac{1}{x^n}.$$

(3). From these two propositions, it is a necessary consequence, that $(2\cos\theta)^n$ must be represented by

$$(x + \frac{1}{x})^n,$$

and that every such term as

$$x^n + \frac{1}{x^n}$$

being equivalent to $2\cos n\theta$,

$$x^{n-2} + \frac{1}{x^{n-2}}$$

is equivalent to $2\cos(n-2)\theta$,

$$x^{n-4} + \frac{1}{x^{n-4}}$$

is equivalent to $2\cos(n-4)\theta$, and so on.

(4). Combining these propositions with the binomial theorem, by which we know that the symbolical expressions

$$(x + \frac{1}{x})^n$$

and the series on the second side of the equation are necessarily equivalent to each other, *whatever the symbols*

$$x \text{ and } \frac{1}{x}$$

mean, provided they are subject to those laws of combination on which the said theorem is founded, we obtain the final result that (after dividing both sides by two)

$$2^{n-1}(\cos\theta)^n = \cos n\theta + n\cos(n-2)\theta + \&c.$$

The reasoning in this process is simply that described above, where O_1 and O_4 are supposed to be intelligible operations, and O_2 and O_3 unintelligible ones. Here $(2\cos\theta)^n$ may be represented by O_1, and the series

$$2\cos n\theta + 2n.\cos(n-2)\theta + 2.\frac{n(n-1)}{1\cdot2}\cos(n-4)\theta + \&c.$$

by O_4.

Both $(2\cos\theta)^n$ and the series denoted by O_4 are perfectly intelligible arithmetical operations, which it is often desirable to be able to substitute for one another. [It is generally the series which we desire to substitute for $(2\cos\theta)^n$].

But

$$(x + \frac{1}{x})^n,$$

which we represent by O_2, and the series

$$x^n + \frac{1}{x^n} + n\left(x^{n-2} + \frac{1}{x^{n-2}}\right) + \frac{n(n-1)}{1\cdot 2}\cdot\left(x^{n-4} + \frac{1}{x^{n-4}}\right) + \&c.,$$

which we denote by O_3, are both unintelligible operations, at least in an arithmetical sense; for, as we have seen, x does not and cannot mean any number whatever. And yet, since we are perfectly certain that these two operations, O_2 and O_3, are equivalent to one another, although we cannot interpret either, it follows, inevitably, that having proved that O_1 is equivalent to O_2, and O_4 to O_3, therefore O_1 and O_4 are equivalent to each other, which is what we wanted to show.

Many worthy people of the "old school" of mathematics (which, with due respect be it said, contains many *old school-boys* who have stuck fast in their education) entertain what is called "a wholesome horror" of these and all other modern practices in the "black art" of algebra. They prefer to put up with the manifold evils and tedious operations of a clumsy arithmetical algebra, rather than "fly to others that they know not of." But although there is no necessity, or even perhaps possibility of their comprehending the nature of such operations as those denoted by O_2 and O_3, they might be convinced of the rigorous and perfectly intelligible nature of the *reasoning* in which such operations are symbolically represented. It is rather surprising that even Woodhouse, who did so much towards advancing the progress from the old to the new mathematics, has in one place (if not in many —I quote the only one that occurs to me) betrayed a suspicion as to the accuracy, or, at any rate, the satisfactoriness of the modern methods, and has even fallen inadvertently into the very methods he has tried to escape from. The passage referred to is in a note to page 261 of his "Physical Astronomy:"

"The development of

$$\frac{1}{y^{4s}},$$

or of

$$(r^{1\,2} - 2\,rr^1 \cos w + r^2)^{-\frac{1}{2}s},$$

was, during his researches on the perturbation of the planets, deduced by Lagrange, and by the aid of impossible quantities. In this method he has been followed by Laplace and other authors, (here follow the references.) The demonstration in the text is obtained with an expedition quite equal to that which the use of imaginary symbols is able to confer." Now, if the reader examines this "demonstration in the text," he will see that it all depends on using

$$x + \frac{1}{x}$$

for 2 cos w,

$$(x^2 + \frac{1}{x^2})$$

for 2 cos 2 w, and so on, which Woodhouse does not seem to have suspected, is quite as "impossible" and "imaginary" as

$$\sqrt{-1},$$

or any symbol which Lagrange and the rest could have used. I say he does not seem to have suspected this; for he refers to his Trigonometry, in which not one syllable is said about this difficulty, and yet Woodhouse was pre-eminently a cautious scrutiniser of the logic and validity of algebraic processes.

(Refer to pages 59—63 of the fifth edition of his Trigonometry, where not only is no mention made of the non-arithmetical meaning of x, but a distinction is actually implied between it and "imaginary symbols," page 63.)

It may occur as a difficulty, notwithstanding what has been said, that intelligible operations are considered in the proof we have just been going through, as equivalent to others which are *not* intelligible: $(2 \cos \theta)^n$ being considered equivalent to

$$(x + \frac{1}{x})^n,$$

for example. And this is, perhaps, the difficulty which is looked upon as the most formidable of any; though it is, in reality, only the same fundamental difficulty and inability to appreciate reasoning processes when carried on by general symbols, which we have been combating all along, in one shape or another. But there is, in truth, an ambiguity in the symbol =, and in its translation "equivalents," to which, probably, the confusion is partly owing. This "equality" or "equivalence" has no reference, and can have no reference to the particular nature of the things signified where no

particular signification is supposed or necessary in the symbols. As we have already repeated several times, the proofs referred to depend solely on the laws of combination of the symbols, and not on the things signified by them. The "equivalence" of 2 cos θ and

$$(x+\frac{1}{x})$$

is not an equivalence or equality in an *arithmetical* sense, but merely in a "symbolical" sense, that is, 2 cos θ and

$$(x+\frac{1}{x})$$

are subject to the same laws of combination, so that wherever in the process I see one, I can substitute the other, without affecting the reasoning.

After all, however, this and other similar difficulties really arise from the want of a distinct and thorough conviction that the theorems of algebra do absolutely depend on the laws of combination alone, and *not* on the meaning of the symbols combined. Recollect, that by the word "Theorem" is meant here simply the algebraical equation, and *not its interpetration.* For example, the "Binomical Theorem," is merely the equation

$$(a+b) \;=a^{n}+n.a^{n-1}.\,b+\&c.$$

Perhaps it may assist the reader to state in words, that this equation considered in a purely symbolical light, signifies that, "Whatever a and b, &c., and their combinations $(a+b)^{n}$, $n.a^{n-1}\,b$, and so on, mean, the result of the operation or operations indicated by $(a+b)^{n}$, is necessarily identical with the result of the operations—be they what they may—indicated by the second side of the equation." If a and b, and their combinations with each other and with the other symbols admit of geometrical interpretations: that is, (as before explained), if we can find geometrical significations for these symbols whose very nature renders the laws of combination (such as $aa=a^2n(a+b)=na+nb$, &c.,) by which the theorem has been obtained, *necessary* laws,—then this final equation expresses a necessary geometrical truth. Of this we have instances in the "algebraical proofs," as they are called, of the propositions in the Second Book of Euclid. For example, the fourth proposition of that book is algebraically expressed thus

$$(a+b)^2=a^2+2ab+b^2.$$

Now, suppose we knew nothing of Euclid's proof, but had the algebraic theorem or equation to start with, and wished to discover whether such geometrical significations can be assigned to the symbols, as shall render the laws of combination by which it was obtained necessary laws. On trial such significations *are* found; namely, if by a and b we consider are denoted the two parts into which any straight line can be divided: by ab the rectangle whose sides are a and b: and by the sign + the same notion as in arithmetic. For, having given such meanings, the laws of combination

$$ab=ba,\ aa=a^2 \text{ or } bb=b^2, \text{ or } (a+b)\,(a+b)=(a+b)^2,$$

are seen, from the nature of the geometrical ideas to be necessary laws. A rectangle whose sides are equal being a square.

If we were to define a purely symbolical equation, by saying that one side was merely *the same thing in other words*, as the other side, we should only be wrong in using the term "words," instead of "combinations of the same symbols." Another definition has been given, in calling what is written on the two sides, "equivalent forms." But let us take the first difinition, and trace the analogy between it, and the incorrect mode of expressing it just mentioned. When we say, in common conversation, "That's only the same thing in other words," our minds go through the same process as when we perceive the truth of a purely symbolical equation. (Some readers may require to be reminded that throughout this article, the term "Equation," must not be confounded with such equations as $x+4=6$, or indeed with any equations which are proposed to be *solved*: the equations here referred to are often termed "Identical Equations," and do not depend in the least on any particular value or values of the symbols, like those numerical equations occurring so frequently in books on the elementary parts of algebra).

In fact, this conversational phrase implies a perception of the *equivalence of certain mental operations*, of which

the words of ordinary language were the signs or symbols. The words uttered by the speaker, A, give rise in the mind of the hearer, B, to certain thoughts; the resulting or final impression on the mind has been the same, in the supposed case, at the conclusion of A's speech, as at the conclusion of some other speech, (by A, or some third person, C,) of which B has remarked that the two speeches "come to the same thing," or, "are the same thing in different words." That is the two trains of mental operation produced by the two speeches, lead to the same final result in the mind of the hearer B.

Ordinary language is, in fact, as much "a calculus of operations," as those more technically styled so. Both "words" and algebraic "symbols" are merely signs of reasoning, and not reasoning itself.

Sentences, and the other similar divisions of writing and speaking, are combinations of these symbols, and represent certain mental operations, just as the combinations of algebraic symbols represent certain operations of a peculiar class. Open a book in a foreign language, perfectly unintelligible to you; the symbols it is which are unintelligible—their *laws of combination* are for the most part the same as those in your own language, and all other languages. You never see an adjective, or a preposition, or an adverb standing isolated from the surrounding words, any more than you see the index ^{n} standing without any base, (*i.e.*, the symbol as written here, instead of x^n,) or the symbol (log.) instead of log. x, except under the same circumstances, indeed, which sometimes require such usages in both, as when we are talking about the *general properties* of those parts of speech called adjectives, adverbs, &c., or of those mathematical functions called log., cos, &c.

I have thus been brought back, insensibly, to the same illustrations as before, and by a very natural path; for in the endeavour to show others the way to some hidden and obscure truth, all the windings end in one and the same terminus. The fundamental conception to which I have endeavoured to conduct the reader, is one of those *idées mères*, as the French call them, which are pregnant with new truths. It is a seed, which if once received into the mental soil and allowed to remain, will expand and grow, by assimilating to itself whatever is congenial to it in the surrounding notions, and will ultimately bring forth abundantly.

MODES OF REGULATING THE SUPPLY OF WATER TO STEAM BOILERS.

Fig. 1.

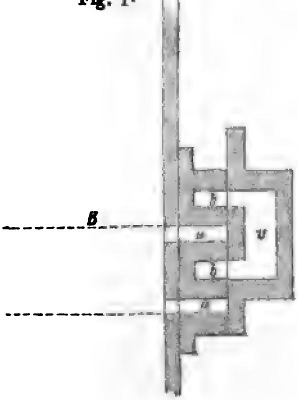


Fig. 2.

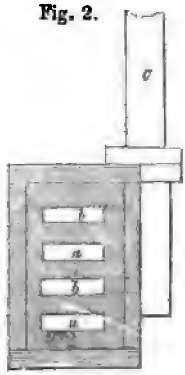
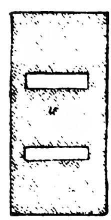


Fig. 3.



Sir,—Herewith I send you drawings of a design for regulating the supply of water to steam boilers, for insertion in the *Mechanics' Magazine*.

B (fig. 1) is a vertical section of part of a steam boiler. *a a*, are two ports leading into the boiler; and *b b*, two ports leading sideways into a pipe, C, as shown in fig. 2. Fig. 2 being a front view of the ports, and fig. 3 a view of the valve face.

The mode of action is as follows:

Instead of the feed-pipe leading direct from the pump to the boiler, I propose pumping the feed-water into a cistern or reservoir, either above the boiler or in any place convenient for heating it, provided it is above the valve; from this reservoir the pipe, C, brings the water to the ports, *b b;* the valve works up and down by a rod from any convenient part of the engine, opening alternately the ports, *a a*, *b b*. Should the water in the boiler be below the upper port, *a*, and above the lower one when the valve has completed its downward stroke, the valve becomes filled with water and steam; upon the valve returning to the position shown in fig. 1, the steam escapes through the upper *b* port into the water pipe, and water instantly fills its place, which, upon the down stroke of the valve, flows into the boiler; thus it will be seen that the water will never rise above the upper port, *a*, or fall below the lower port, *a*, provided the valve is of sufficient size.

Fig. 4.

Fig. 5.

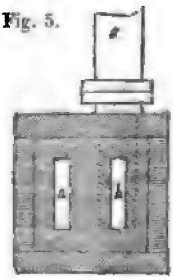
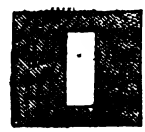


Fig. 6.



Figs. 4, 5, and 6, represent another plan for effecting the same object, requiring but two ports instead of four; this valve is worked in a horizontal direction. B (fig. 4) being a horizontal section of part of a steam boiler; fig. 5, a view of the ports, and fig. 6, the valve face.

The above valves require to be kept in their place by springs, but D valves may be used with the valve-box open at each end and packed in the usual manner. In steam-boats there should be a shifting connecting-rod to connect the valve either with the engine or the donkey. The two dotted lines, fig. 1, show the extreme levels of the water.

I am, Sir, yours, &c.,

T. Moy.

1, Clifford's Inn, Oct. 2, 1848.

P. S.—By the above plan the water may be supplied to the boiler without limiting the temperature or pressure.

MODE OF COATING WIRE WITH GUTTA PERCHA FOR ELECTRICAL PURPOSES.

Sir,—The following method of coating wire with gutta percha for electrical purposes, I employed many months ago.

The wire to be coated was passed round a pulley immersed in a solution of gutta percha (in bisulphuret of carbon) contained in a glass jar. The pulley was attached to the under side of the lid of the jar. The lid had two holes in it through which the wire passed in and out. The wire, after passing round the pulley, was drawn through a tube fixed in one of the holes in the cover. A series of soft, circular brushes were inserted in this tube. It (the wire) was then carried upwards over another pulley—vertical to the tube, and fixed at a great height—and again brought to the ground.

In passing round the *pulley* in the jar the wire was coated with the solution, and in passing through the *tube* the brushes removed the superfluous solution and distributed it evenly. By the time the wire reached the second pulley, the bisulphuret had evaporated and left a thin coating of gutta percha.

The wire could be covered very fast, as the solvent is very volatile. The coating being thin is easily injured. Where good insulation is required, and where

the wire would be used roughly, I think it would be well to cover the wire with *cotton in the ordinary way*, and afterwards pass it through the solution of gutta percha. I think this plan would be useful for telegraphic wires, if not too expensive. It would certainly be very *durable*, though perhaps not more expensive than gutta percha tubing of sufficient thickness to be effective.

I might observe that I found it necessary to have the brushes in the tube *revolve*, and so pass over the surface of the wire *transversely*.

I am, Sir, yours, &c.,

VOLTA.

13, Mosley-street, Newcastle-on-Tyne,
October 10, 1848.

THE SEA-WALL QUESTION.

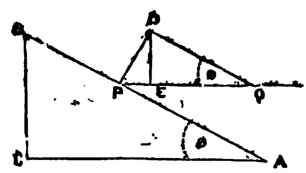
Sir,—The subject of sloping and vertical sea walls has been discussed with considerable interest by several of your correspondents, and I hope not without some profit to many of your readers; and certainly I am not prepared to aid in bringing to a close a question of so much interest and importance, by entering into a personal wrangle even with the distinguished author of the "Replies." While, however, his last communication renders it indispensable that I should offer some explanation, I am sure your readers will readily draw the necessary distinction between the discussion of a subject of great practical importance, and a little bye skirmish upon a point of science, which, however valuable in its own way, may, after all, have but little to do with the real merits of the "Sea-Wall Question."

It is not for me to draw the line of relationship which exists between your correspondent and that eminent personage, the author of the "Protest;" it is not for me at a distance to even speculate upon this difficult point; but it appears to me extremely unfair that your correspondent should collect the arguments and observations which obviously arose out of *his own* communication, and charge them as so many offences against Sir H. Douglas. Why should this writer not take his stand upon the bottom of his own "Replies," rather than thus endeavour to shield himself behind the exalted name and eminent reputation of Sir Howard Douglas? I confess I am quite unable to understand the unfair position in which your correspondent has endeavoured to place me.

And now, Sir, with these few observations I shall pass on to something more interesting. A question in hydrodynamics, purely theoretical, is mooted, perhaps for the first time, "since the days of Galileo" by your correspondent, involving not only his own character as a scientific man, but unquestionably that of Sir Howard Douglas. The investigation of this "well known law" has been introduced to the notice of your readers in page 342 (*ante*) under circumstances apparently very unfavourable to me; the spirit of forbearance is there invoked in my behalf, and the veil of charity compassionately extended over my nakedness, while the oracle speaketh for my peculiar edification! Charitable this; and cool withal! But the inestimable virtue which covereth a multitude of sins usually "begins at home," and we shall presently see whether she had any occasion to become an itinerant in the case of your correspondent, and seek a foreign field as the sphere of her benevolence.

(*Extract.*)

"Let then q (represented by P Q in the accompanying diagram) denote the pressure exercised in a horizontal direction by an indefinitely slender filament of the fluid terminating at P on the face of the wall, supposing that face to be in a *vertical position or parallel to B C*. Let ϕ denote the



angle B A C at which the face B A of the wall is *inclined to the horizon:* it will also denote the angle A P Q, or P Q D, that is the inclination of B A or D Q (parallel to B A) to the line P Q. Then by trigonometry, $q \sin\phi$ ($=$ P D) is the pressure resolved perpendicular to B A; and D E being drawn perpendicular to P Q, $q \sin^2\phi$ ($=$ E P)

is the effective horizontal pressure of the filament on the inclined plane B A.

"Now the number of filaments which act horizontally on B A is evidently equal to the number which would act in the same direction on B C; if n represent that number, then $n q$ would denote the horizontal pressure against an upright wall B C, while

$$n q \sin^2 \phi \ldots\ldots\ldots\ldots\ldots \quad (1)$$

represents the horizontal pressure against B A. The pressure that would take place against the upright front, B C, is therefore diminished by the construction of the inclined plane in the ratio of unity to $\sin^2 \phi$; *and this is exactly in accordance with what is stated in the Note appended to Article* ii. *of Sir Howard Douglas's 'Protest.'*"—(*Vide* p. 343 *ante.*)

Permit me now, Sir, to point the attention of your "charitable" correspondent to his own production as given in the expression marked (1). There it stands in immortal type, the veritable offspring of his own benevolent brain; still, however, it comes in such a "questionable shape" that I must speak to it. It will be observed, that the expression is composed of three quantities, two of which (q and ϕ) are simple factors and may give but little trouble; but how will your correspondent escape from that *compound* of treachery, the symbol n? What is the interpretation of that symbol? Why nothing less than "the number of filaments which would act in the horizontal direction on B C." Is not n then, $f(\phi)$, or can the mind conceive a change in n, without a consequent change taking place in ϕ or *vice versâ*. Is not $n = $ A B. $\sin \phi$ true under every imaginable variation of the quantities?* Substitute therefore, in expression (1), the value of n in terms of ϕ, and it becomes what it ought to be, $AB.\ q \sin^3 \phi$, for the horizontal impulse.

It is now mine to draw the veil of charity, and in doing so with all sincerity, I shall use none of that contemptuous commiseration so unsparingly employed against myself, and which I might now retort, perhaps with some effect, were I so disposed. I shall forbear to do so, as I believe there are parties concerned in this matter whose position must always command the utmost respect. The "*fundamental theorem*," however enunciated in the note appended to Art. ii. of Sir Howard Douglas's "Protest," is a *fundamental error*, and it is now beyond the power of man to redeem it.

Your correspondent says something in his last "Reply" about comparing planes of 50 feet and 250 feet, &c.; and it is positively impossible to say whether he is writing upon water at *rest* or in *motion*. If he understood the full meaning of $\sin \phi$ which expresses the ratio of B C to A B, we might probably have been spared all that is said upon this point; instead however of entering upon the fruitless task of explanation, I can only deny all the nonsense which is attributed to me, and shall feel obliged by your correspondent abstaining in future from misrepresenting my opinions.

In order that I may not again be called upon to enter on this unpleasant subject, which I have neither time nor inclination to pursue, and which hitherto has been forced upon me, I shall here refer to the following works in which the disputed point is fully discussed, and which I have selected as presenting perhaps the greatest variety in the mode of treating the subject. Should the reader bear in mind that the point in question is the horizontal impulse or motion in the direction of the axis of the plane, he will have but little trouble in satisfying himself by reference to *Moseley's Hydrodynamics*, page 189; *Hutton, by Ramsay*, page 590; *Lardner's Hydrostatics*, Cab. Cyc., p. 188.

Respectfully yours,

T. Smith.

October 11, 1848.

* To meet the note of a "*Constant Reader*," who seems so much "surprised," page 369 (*ante*), it may be enough to observe *en passant*, that the equation $n = $ A B $\sin \phi$ being true under every possible circumstance of the case, it is true when B C or n is *constant*.

MECHANICAL TRUTHS, LOGICAL FALSEHOODS.

Sir,—I venture to put before you the following remarks, not knowing positively that they are new, but judging them to be so, since they would, according to my judgment, at least, make that to be clear and reasonable, which now appears dark and contradictory to reason.

The case in question is this:—Matter is infinitely divisible, therefore an inch is infinitely divisible, or contains an infinite number of parts. Now in passing over one inch, a portion of time must

be occupied in passing over each of its parts. Since it contains an infinite number of parts, an infinite number of portions of time must be occupied in passing over all the parts. But an infinite number of portions of time would constitute an eternity; therefore it would take an eternity to pass over an inch. We all know the conclusion here to be absurd, and yet the premises are correct, and the deduction appears logical. Thus reason and experience appear to contradict each other.

The fallacy appears to me to lie in the deduction, and to be capable of remedy in the following way:—We can only consider any portion of matter—a marble for instance—as capable of being divided into an infinite number of parts, by supposing each of those parts to be *infinitely small;* if we suppose each of the infinite number of parts to be of finite dimensions, we then, in taking the aggregate, have the result, a marble of infinite dimensions; an absurd conclusion, similar to that deduced in the case of the inch.

Therefore, in dealing with such questions, we should clearly understand *that an infinite number of quantities, infinitely small, produces only a finite result.* Acting upon this principle, the difficulty disappears at once. The inch is divided into an infinite number of parts, each infinitely small. The period of time occupied in passing over each of these parts is also infinitely small; an infinite number of these infinitely small portions of time constitutes a finite result, which is the time really occupied in traversing the inch.

There is another case in which a want of attention to this simple principle appears to have led to an absurd conclusion. The curve and asymptote of the hyperbola eternally approach each other, but never meet! Common sense tells us that if two lines eternally approach each other, they must meet at some period. It appears perfectly axiomatic to assert that converging lines infinitely produced in the direction of their convergence, must meet somewhere. Yet our proposition lies directly in the teeth of this axiom. Now it appears to me that the difficulty is at once removed if we apply the principle which I have just laid down to this case. In asserting that these two converging lines never meet, we must allow that they get nearer to each other, though not near enough to come in contact. If we consider that these two lines approach each other by *infinitely small* advances, we may allow that in an eternity they will pass over an *infinite number* of these infinitely small portions of space, which will only constitute a finite result, and all that we are warranted in considering as proved, is simply, that the finite distance by which these two lines get nearer to each other, is less than the distance which originally existed between them.

Whether some of your ingenious correspondents will carry these views further, or bring them forward as another proof of the fallability of human reasoning, I know not; but with more hope than assurance am inclined to look for the former result.

I remain, Sir, yours, &c.,
J. PITTER.

St. Mary's Terrace, Hastings, October 5, 1848.

THE ORIGINATION OF THE RAILWAY SYSTEM.—THE RIVAL CLAIMS OF WILLIAM JAMES AND GEORGE STEPHENSON.

A memoir of the late Mr. George Stephenson having recently appeared in the *Derby Reporter*, in which the chief, if not the entire, merit of originating the railway system, in the modern adaptation of it, to the conveyance of passengers as well as goods, having been ascribed to that gentleman—in which particular, as all the world knows, the writer but echoed the statements of the subject of the memoir himself, while in life—this has called forth the following letter from "A Coal and Ironmaster of Staffordshire," in which he asserts the superior claims of William James to that high distinction:—

The Originator of the Railway System.

Sir,—In the course of the biographical sketch of the late George Stephenson, C.E., in the *Derby Reporter*, there appear to be a few points requiring explanation, which it is just and proper should be made known to the public. It does not state that he was co-partner with Mr. William James, of London, land agent and engineer in the locomotive patent, or that the latter was the actual originator of the railway system forty years since, by his proposing a line from these towns to Birmingham, through the colliery districts, and a communication from thence by canal to Stafford, and by the river Avon to Bristol, and subsequently his more grand

project, the Manchester and Liverpool line, for engine-passenger traffic; and his letter to the Prince Regent, in 1815, shows that he entertained the idea of rapid locomotion by steam and other agents several years antecedent to it, but the time was not ripe for the project. The biographical notice gives to Mr. Stephenson the undivided honour, by calling him the "father of railways," when it should have referred principally to the improved locomotive engine. The railway machinery has been brought to its present perfection by the combined engineering talent of the nation. William James was really the leader, and the only successful agitator of the subject—the first person who gave the impulse to the ponderous mass of inertia in the public mind, by which vigorous effort the mighty movement commenced, and has been since kept up by Mr. G. Stephenson and his talented son, and other eminent engineers of the age. No one could have succeeded in that undertaking but such a man as William James, who all his life had been accustomed to struggle with and execute difficult projects, who possessed a wide connection with the nobility and great landed proprietors, with whom he was accustomed to mix, and to negociate matters of business. Being a man of good education, tact, and of business habits, he was in all respects the very best captain to attack the strongholds of ancestral prejudice, followed up and supported by Stephenson's practical ability. Mr. Robert Stephenson was then a minor, and had not finished his education at the University, but was acting as an assistant-surveyor on the line, under Mr. James, two years before his father received the appointment of engineer, which had been offered to Mr. James, but which his peculiar circumstances prevented his accepting; and I understood at the time that it was through this recommendation that Stephenson proposed three hundred pounds to be presented to the widow of his partner by the Company. It is quite evident, that if two such minds had not been brought happily into apposition, that the railway system might have been successfully opposed—that the engineering talents of a Stephenson might not have been known, and that all the iron sleepers might have slept on still in mother earth, and its great benefits denied to the present generation. To William James alone belongs the merit of being its earliest agitator, *in all parts* of the kingdom—in making the survey of the first line, and organising the first Company, and lodging the first Report and Plans of the Manchester and Liverpool Railway. And he had done much in experiments and surveys in various places, but without patronage, at his own expense, previously. This ought not to be forgotten or overlooked; indeed, if ever a national monument should be erected commemorative of this great benefaction, I should propose that the busts of James and Stephenson should be placed together, as they have equal claim to the nation's gratitude. The contrast is remarkable in the success in life of the two parties, and there appears to be some mistake and confounding of the labours and position of each. William James was the party who "underwent something akin to persecution;" he it was who had to bear the first shock of the contest; and this persecution seems to have descended on his family. The taunts of the vulgar-minded only stimulated him to acts of extraordinary energy, kept up for nights and days, until they gave way from natural exhaustion, or change of events and situation. The sons of genius do not often combine within themselves the faculty of self-interest—the especial glory and climax to be aimed at in vulgar eyes—and thus for being rich and becoming poor for the public benefit, he has been reviled at, and pointed at with the finger of scorn *during* his agitation of this project. William James was, before he commenced his speculative career, Lord of Snowford Manor, and raised one hundred men as volunteers in Warwick at the time of the threatened invasion, and was elected major, and was presented with a sword worth sixty guineas on their being disbanded; and it was shown that his property exceeded £100,000 in value. The last reserve of this fortune was expended in this project of the railway system. He lived through the pelting of the wintry storm, but his more fortunate coadjutor, without education or address to propose a public measure, rose from poverty to wealth in the summer glory of the scheme, and died proprietor of Tapton House. He deserves all the honours that have been heaped upon him; but does not Mr. James's *successful* efforts and *personal* sacrifices in this, and many other great undertakings, also deserve commemoration and regard? I was at Liverpool for my health at the period of the first survey, and had opportunities of seeing the parties almost daily, and I do think you will do justice to the memory of William James (originally a Warwickshire man), by introducing this humble sketch into your valuable Journal.

I am, Sir, yours, &c.,

A COAL AND IRONMASTER OF STAFFORDSHIRE.

Stafford, September 7, 1848.

We believe the statements in this letter to be in the main perfectly correct. To what the writer alludes in saying that

Mr. James was "co-partner" with Mr. Stephenson "in the locomotive patent," we do not know, and rather think that he is so far under a mistake. We can find no trace of any joint patent in the names of James and Stephenson, or Stephenson and James. Mr. Stephenson had a joint interest in two patents relating to railways—one taken out as early as 1815, along with the well-known Ralph Dodd, one of the most speculative and not least clever engineers of his day, and the other dated in the year following, in which he was conjoined with Mr. Losh; but in his other patents he stood alone. Mr. James, too, had his railway patents, but none of an earlier date than 1824.

That Mr. James was indeed the author of the great railway movement of 1825, we have the means of placing beyond all doubt by a document in our possession, a literal copy of which we subjoin. We give publicity to this document not without considerable reluctance, because it involves the unpleasant necessity, of setting up the testimony of a gentleman no less respected by the world at large for his high professional attainments, than beloved by all who know him for his social virtues—whom no one would willingly pain, knowing how regardful he always is of the feelings of others—in opposition to the self-delusions of a parent, whose memory must on every account be inestimably dear to him. All personal considerations must however give way to the claims of truth. *Amicus Plato, amicus Socrates, sed majis amica veritas.* To this document, which assigns, with unimpeachable specialty and distinctness, to William James, that prominent place in railway history which George Stephenson was so habitually fond of asserting for himself, are subscribed the names of nearly all the most distinguished railway engineers of this railway era, including in the second foremost place that of "ROBERT STEPHENSON"! Need we press the weight to be assigned to such testimony as this? To our thinking, it is such as should set the question in issue, at rest for ever.

James Testimonial.

Temporary Office, 55, Gracechurch-street.

We the undersigned hereby consent to act as a Committee for promoting a General Subscription for the four sons and one daughter of William James, Esq., deceased, Civil Engineer, and Land Agent, viz., W. H. James, J. H. James, G. W. James, T. F. W. James, and Mrs. Paine, in consideration of their father's public services, as the original projector and surveyor of the Manchester and Liverpool Railroad, and many other of the most important railroads in this kingdom, principally at his own cost: We being of opinion that the great benefits conferred upon this country in particular, and the world at large, by his successful exertions, and great pecuniary sacrifices to the injury of his family, (who were thereby deprived of all patrimony, and have suffered great privations for more than twenty years) entitle them not only to public sympathy, but also compensation:—it being an acknowledged fact that to their father's labours the public are indebted for the establishment of the present railroad system.

R. Harvey, 55, Gracechurch-street.
Robt. Stephenson, 24, Gt. George-street.
Joseph Locke.
George Rennie.
George Landmann.
Wm. Healy, 180, Fleet-street.
Joseph Woods, Bucklersbury.
Edward J. Starbuck.
Stopford Thos. Jones.
J. C. Robertson.
J. K. Brunel, 18, Duke-street.
Charles Vignoles.
John Macneill, 9, Whitehall-place.
John Sylvester, 96, Great Russell-street.
J. E. Errington.
Joseph Taylor.
Charles John Blunt.

July 12th, 1845.

How the "Testimonial" thus powerfully recommended to the favourable consideration of the public came to nothing—by what influence it was crushed, literally crushed, ere it came fairly before the public, we are not called upon here to state, and willingly refrain from going into particulars. We cannot conclude, however, without asking whether it is too late for the public yet to do justice to the James family? We fancy it only requires that the project of the "James Testimonial" should now be energetically revived, to command universal support.

MR. THOMAS GRAY—HIS DEATH, AND CLAIMS TO THE TITLE OF "THE RAILWAY PIONEER."

In penning the preceding notice, we were not unmindful, that claims adverse to those both of James and Stephenson had been set up on behalf of Mr. Gray, whose death, under very melancholy circumstances, is recorded in the subjoined extract from the *Morning Chronicle*. Gray did, no doubt, take a very early and zealous part in awakening the public mind to the advantages of a general railway system; but it was by his pen merely; and there is one other person, at least, who did the same thing (if not as much) several years before Gray's appearance in the field. Gray's "Observations on a General Iron Railway," on which all his claims rest, is dated in 1820; but as early as 1813, the late Sir Richard Phillips thus expressed himself in his once highly popular and much read "Morning's Walk to Kew."* (The railway to which he alludes was the Surrey tram railway, the first ever established (1801) in England for general traffic):—

"I found renewed delight in witnessing at this place (Wandsworth) the economy of horse labour on the iron railway; yet a heavy sigh escaped me as I thought of the inconceivable millions which have been spent about Malta, four or five of which might have been the means of extending double lines of iron railway from London to Edinburgh, Glasgow, Holyhead, Milford, Falmouth, Yarmouth, Dover, and Portsmouth! A reward of a single thousand would have supplied coaches and other vehicles, of various degrees of speed, with the best tackle for readily turning out; and we might, ere this, have witnessed our mail coaches running at the rate of ten miles an hour, drawn by a single horse, or impelled fifteen miles an hour by Blenkinsop's steam-engine. Such would have been a legitimate motive for overstepping the income of a nation; and the completion of so great and useful a work would have afforded rational ground for public triumph in general jubilees!"

Gray did but advocate and enforce the scheme thus clearly ennunciated seven years before.

It is to be recollected besides, that in Gray's hands the scheme was marred somewhat, by the infusion into it of a foolish crotchet of his own; and that the shape in which the railway system triumphed at last was something quite the reverse of that which Gray always contended for—to the very last, we believe. Gray was all for the *cog* system, and very angry with the Directors of the Liverpool and Manchester Railway for not adopting it on their line. (See *Mech. Mag.*, vol. xxi., p. 182.) Had the railway forces followed in the track marked out for them by their "Pioneer" (a title, however, which it is only fair to Gray to say he did not himself assume, but was indebted for to the partiality of his friends,) they could never have achieved such wonderful triumphs as they have done, or indeed anything at all approaching to them.

Now, the difference between Gray and the other parties whose claims we have touched upon in the preceding article is this, that while he only talked (at second hand) they set about the actual work, and had commenced upon it, long before Gray was ever heard of, and most certainly without deriving any of their inspiration from him; this also, that they took up and carried into effect that *edge-rail* mode of construction which Gray so uniformly decried, but which is nevertheless at the bottom of all the success which has attended the railway system.

The following is the notice in the *Chronicle*.

Death of Thomas Gray, the Railway "Pioneer."

During the last week Thomas Gray, whose friends claim for him the titles of "author of the railway system" and the railway "pioneer," died at Exeter, in the 61st year of his age. Though not an engineer, he was contemporary with the late George Stephenson. His name was brought into note by the publication, in 1820, of a work entitled "Observations on a General Iron Railway, or land steam conveyance to supersede

* We are indebted for this opportune reminiscence to the *Manchester Examiner*.

the necessity of horses in all public vehicles, showing its vast superiority in every respect over all the present pitiful methods of conveyance by turnpike-roads, canals, and coasting traders." At the time Gray's book was written, all that was known of railways was as they then existed in the rude tramways at Newcastle and its collieries, and considerably before the construction of those earliest of our railways, the Stockton and Darlington, Liverpool and Manchester. The gist of Gray's suggestion was to carry out a comprehensive railway at one stride over the whole United Kingdom; in fact, to make a simultaneous system to all the principal towns, instead of making the work a labour of section and degree. The progress of the railway system, however, proved that this was impracticable in many, but more especially in monetary points of view, and the suggestion, from its very comprehensiveness, perished. In 1825 he petitioned Parliament and Sir R. Peel, but received no encouragement. Latterly he was reduced to poverty, and sold glass on commission. Appeals were made to the railway world on his behalf, but they met with no response, and it is said that he died broken-hearted.

WEDGWOOD'S CLIP DESK.—COMPANION TO WEDGWOOD'S PATENT MANIFOLD WRITER.

[Registered under the Act for the Protection of Articles of Utility. Ralph Wedgwood, of Rathbone-place and Lombard-street, London, Proprietor.]

We have the pleasure this week of introducing to our readers a very useful appendage to that well-known and valuable invention, "*Wedgwood's Patent Manifold Writer.*"—Of the great utility of that apparatus it is now superfluous to speak, and it is indeed impossible to speak too highly, saving as it does so much labour and time in copying letters, and producing with so much accuracy, dispatch, and secrecy, not only the copy of a letter, but as many as eight duplicates, or rather fac-similes, at one operation—an effect that can be produced by no other machine that we know of. One thing it did want, to make it perfect (not in principle but in application), namely, some means of holding down the leaves while the machine was in use; and this Mr. Wedgwood has now supplied in the "*Clip Desk*," which forms the subject of the present registration. With this addition we feel assured the public will join with us in saying that Mr. Wedgwood's Patent Manifold Writer leaves nothing more to be desired.

Mr. Wedgwood has also greatly improved the materials used with his desk. His carbonic paper as it is now manufactured, is of a much finer and blacker appearance than any we have seen before. His copying paper, too, is beautifully white and transparent, and at the same time wholly free from smell. Both materials have the reputation—well deserved, we believe—of retaining their good qualities for any length of time and in all climates. Sir Edward Parry used them with immense advantage in his arctic voyage. While all liquid inks became congealed and utterly useless to him, the Wedgwood machine and papers continued as serviceable as ever.

REMARKABLE EXPERIMENTS IN EBULLITION.

M. Marcet boiled distilled water in a balloon that had contained sulphuric acid heated to 302° F., but had subsequently been well washed. He observed the following phenomena:—The water in the balloon commenced to boil regularly between 212° and 213·8° F.; but almost immediately after the ebullitionary movements slackened visibly, the bubbles of vapour soon ceased to rise uniformly from the whole surface of the balloon, a few bubbles only sprung from time to time from certain parts of the balloon, and the separation of these bubbles from the sides of the vessel proceeded by sudden and violent bursts. The thermometer rose rapidly to between 217 and 219. M. Marcet now increased the flame of the spirit lamp; this proceeding seemed, as it were, to force on the production of vapours; the number of bubbles augmented, but they continued to form with difficulty and to separate from the sides of the vessel by bursts. At the disengagement of every puff of vapour the thermometer fell suddenly to the extent of several tenths of a degree, rising again immediately after. M. Marcet now diminished the intensity of the flame suddenly, whereupon the ebullitionary movements ceased almost completely, *but the thermometer, instead of falling, rose suddenly to between* 221° *and* 223° *F.* At this elevated temperature the water continued for several seconds without the disengagement of a single bubble, or the manifestation of any of the usual signs of ebullition. Upon increasing anew the intensity of the flame, a few large bubbles detached themselves with difficulty, and the thermometer fell by 1·8 to 2·6 degrees, rising anew im-

mediately on diminishing the intensity of the flame. Whilst the thermometer was marking 222° F., and the ebullition of the water seemed almost entirely suspended, a few iron filings were thrown into the balloon; the result was instantaneous: *the ebullition recommenced with considerable energy;* every metallic fragment formed a species of focus from which sprung innumerable bubbles of vapour, and the thermometer fell immediately to about 212° F. The same result ensued, though in a less degree, upon the introduction of a pinch of pounded glass into the balloon. The suspension of a small fragment of iron in the water (in a manner to keep the metal from contact with either the sides or the bottom of the balloon) produced similar effects, but in a much less degree, the thermometer falling rarely below 217·4° F.

M. Marcet tried the same experiment with alcohol; the results were the same as those obtained with water.

Finally, M. Marcet has shown that, whatsoever the nature of the boiler, the temperature of the steam is invariably lower than that of the water from which the steam is generated. In glass vessels this difference amounts on an average to 1·908 degrees, in metal vessels only to between 0·27 and 0·36 of a degree.

There is but one exception from this rule, viz., where the inside of the boiler is coated with a thin layer of sulphur, or gum-lac, or any other matter possessing an adhesion for water; in that case the boiling water and the steam have the same temperature.

We see accordingly that, contrary to the generally received notion, it is not in metal vessels that the ebullition point is lower under a stronger pressure, but in glass vessels, if the latter are coated inside with sulphur, gum-lac, &c.—*Professor Louyet.*—*Pharmaceutical Times.*

GUTTA PERCHA ELECTRIC INSULATORS.

Sir,—A letter which appeared in your Journal of the 14th inst., from Mr. "Thomas Andrews," must have excited much surprise in the minds of most of your readers, few of whom, I apprehend, can at this time of day, be ignorant of the water-repellent properties of gutta percha. With regard to his plan for insulating the telegraphic wire, I have nothing to say; but to his assertion that "a storm would saturate the tubes, or cause them to become damp, sufficiently so to become conductors," I must venture to give a most unqualified denial. So far from that being possible, gutta percha is not in the least affected by wet or damp. To his inquiry whether gutta percha possesses the same valuable property as glazed earthenware, viz., "that of collecting the water in drops, instead of allowing it to diffuse itself equally over the surface of the insulator?" I have this answer to make—that whether it does so or not, is a matter of no consequence, since certain it is, that whatever becomes of the drops, they do not penetrate into the gutta percha. To assert that a tube of gutta percha will "become wet throughout its entire surface," is to display an amount of ignorance upon so common a subject is unjustifiable in one who takes upon himself to oppose publicly the plans of others, especially a gentleman of Mr. Hammerton's great practical experience.

I am, Sir, yours, &c.,
M. G.

NOTES AND NOTICES.

Franklin's Discoveries.—Of all this great man's scientific excellencies, the most remarkable is the smallness, the simplicity, the apparent inadequacy of the means which he employed in his experimental researches. His discoveries were all made with hardly any apparatus at all; and if, at any time, he had been led to employ instruments of a somewhat less ordinary description, he never rested satisfied until he had, as it were, afterwards translated the process, by resolving the problem with such simple machinery, that you might say he had done it wholly unaided by apparatus. The experiments by which the identity of lightning and electricity were demonstrated were made with a sheet of brown paper, a bit of twine or silk thread, and an iron key!—*Lord Brougham.*

Electric Telegraph Lawsuit in America.—A great lightning law-suit, between Morse, Kendall, and Co. and H. O'Reilly, is now being tried before the Federal Court, at Frankfort, Kentucky. The case is one of the most important ever contended for in the United States. Morse, Kendall, and Co. contend for an exclusive monopoly of the principle of electro-magnetism in its application to telegraphing in the United States. O'Reilly's counsel resist the claim, asserting that a general principle like electro-magnetism cannot possibly be made the subject of a patent, even if the claimants had discovered said general principle. Both sides have employed the ablest counsel, and no less than three telegraphs, Morse's instrument, the Columbian instrument, and the invention of Dr. Stiernhiel, of Bavaria, have been put up in the court, for the purpose of explaining telegraphic operations.—*Boston Journal.*

Naphtha.—The very loose application of the name "naphtha," which originally belonged to volatile hydrocarbonaceous liquids found at certain places in the earth, and which has since been adopted for the somewhat similar substance distilled from coal tar, as well as for the very different pyroxylic spirit, is productive of frequent inconvenience. A greater precision in our common nomenclature is highly desirable. It would be an improvement, perhaps, if the word "naphtha" were accepted as a generic term for liquid hydrocarbons of ascertained or probable pyrogenous origin (or even without this restriction,) and if a special prefix were always used to indicate the nature of every particular instance. Thus earth or native naphtha, schist-naphtha, animal-naphtha, &c., would be at once intelligible. Wood-naphtha would designate the interesting hydrocarbonaceous fluids of wood-tar, and would leave the term

"wood-spirit" to the compound to which it is already appropriated, and which has already as many synonyms as can reasonably be required. Additional epithets would mark the distinct substances obtained from any one source: thus, in the case of coal-tar, which yields two sorts of oil having the well-marked difference of being, one lighter, the other heavier, than water, there would be light coal-naphtha, and heavy coal-naphtha, which terms will be adopted in this paper.—*Mr. C. B. Mansfield.—Pharmaceutical Times.*

WEEKLY LIST OF NEW ENGLISH PATENTS.

Samuel Cunliffe Lister, of Manningham, York, gentleman, for improvements in preparing, heckling, and combing wool and other fibrous substances. October 19; six months.

Frank Clarke Mills, of Deptford, Kent, manufacturing chemist, for improvements in treating certain salts and gases or vapours. October 19; six months.

Robert Angus Smith, of Manchester, for improvements in the application and preparation of coal tar. October 19; six months.

Robert William Sievier, of Upper Holloway, Middlesex, gentleman, for improvements in the means of warping and weaving plain and figured fabrics. October 19; six months.

Joseph Eugene Assert, of Lille, in the republic of France, machinist, for improved means of obtaining motive power. October 19; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Oct. 13	1617	James Marr, John Gallie, and Co.	London, Edinburgh, & Dublin	Script type.
,,	1618	Welch and Margetson	Cheapside	A Poncho wrapper.
14	1619	G. F. Bowers, Thomas Betteney and Edward Challiner	Brownhills, Staffordshire; Longton, Staffordshire; Tunstall, Staffordshire	Magnetic slips and glaze troughs.
16	1620	J. Presland	Charlotte-street, Blackfriars-road	Hatband.
17	1621	Alex. Chaplin	Limehouse	Smiths' portable furnace.
,,	1622	George Pitt	Bishopsgate	Package for lard.
,,	1623	William Middleton	Birmingham	Springs for buffers and draw-bars of railway carriages.
18	1624	John and James Mc Rae	Ave Maria-lane	Inkstand.
,,	1625	W. and T. Avery	Birmingham	Weighing machine.
,,	1626	Capper and Waters	Regent-street	Tasca collar.

NOTICES TO CORRESPONDENTS.

A stamped edition of the Mechanics' Magazine to go by post, price 4d., is published every Friday, at 4 o'clock, p.m., precisely, and contains the New Patents sealed, and Articles of Utility registered during each week, up to the time of going to press. Subscriptions to be paid in advance. Per annum 17s. 4d., half-yearly 8s. 8d., quarterly 4s. 4d. Post-office Orders to be made payable at the Strand office, to Joseph Clinton Robertson, of 166, Fleet-street.

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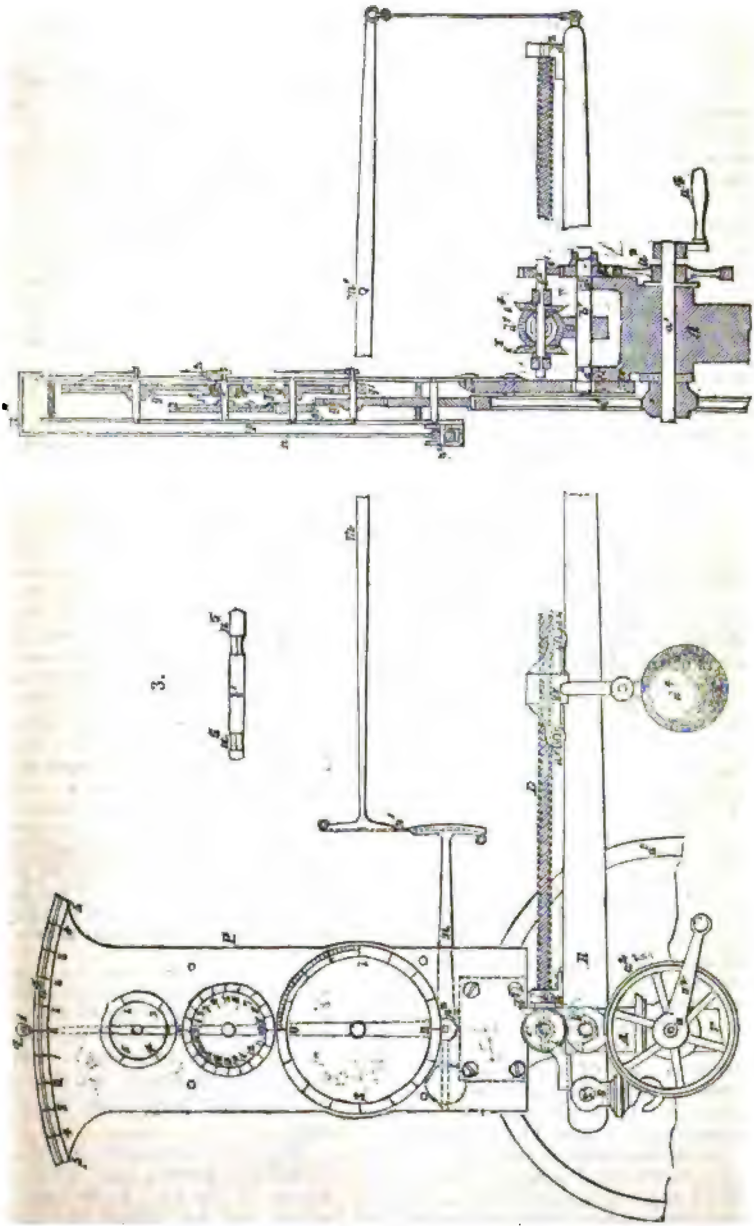
ALLIOTT'S PATENT PLATFORM WEIGHING MACHINE.

Fig. 2.

Fig. 1.



ALLIOTT'S PATENT PLATFORM WEIGHING MACHINE.

[Patent dated March 14, 1848. Patentee, Alexander Alliott, of Lenton Works, Nottingham. Specification enrolled September 14, 1848.]

THE improvements embodied in this new platform weighing machine, have principally for their object such an arrangement of the steel-yard, the weights, and the index in platform balances, that the results may be read off on dials, free from any of that incorrectness arising from friction, or from the want of ultimate exactness of level, which is so frequently experienced in the balance apparatus now ordinarily used with dial-plates and platforms connected; and that these results may be read off, moreover, at different and moderately distant places. A platform-balance or weighing machine on this improved plan is represented in the accompanying figures.

Fig. 1 is a side elevation of the machine, and fig. 2 is a transverse section on the line, $q\ r$, of fig. 1. A is the standard which carries the steel-yard, B, and the other parts of the apparatus. The upper edge of the steel-yard is made straight and supported by the knife-edged spindle, b^1, which has its bearings, $a^5\ a^5$, in the standard. The knife-edged spindle is shown separately in fig. 3. S is a shackle which is suspended upon knife-edged centres, S^1, inserted in the end of the steel-yard and connected to the levers of the platform in the usual manner. D is a screw resting in bearings, d^1 and d^2, which keep it in parellelism with the top of the steel-yard, B. The screw works in a nut, d^3, to which the counter balance weight d^4, is attached, $d^5 d^5$, are two carrying pulleys which serve to facilitate the movement of the weight, d^4. a^1 is a shaft which passes through the standard A, and has a wheel, a^2, in front with another wheel, a^3, at the back of the standard fastened to it. a^4 is a handle for turning the shaft, a^1. E is a spur wheel which turns loosely on the spindle, b^1, and gears into the wheels, a^2 and e^1, the latter of which communicates motion to the wheel, e^3, which gearing into the wheel, d^7, turns the screw, D. e^4 is a supplementary bevel wheel which turns loosely on the shaft, e^2. The wheel, a^3, forms the first of a series of wheels for working the index-hands of the dial-plates, which are fixed upon the frame, P, and which frame is fixed to the standard, A. The machine shown in the figures (by way of exemplification) is supposed to be capable of weighing up to five tons. The upper dial-plate indicates tons, the central one hundred weights, the lower one quarter of hundred weights and pounds; so that when the index-hand of the upper dial-plate has reached the mark indicating one ton, the index hand of the central dial-plate must have made one complete revolution, and the index hand of the lower dial-plate twenty complete revolutions. And to produce these results, the wheel, A^2, in making four revolutions, causes the wheel, d^7, (through the wheels E, e^1, and e^3,) to make sixteen revolutions, and thereby to move the weight, d^4, on the steel-yard, by means of the screw, D, through a distance calculated to counterbalance one ton. At the same time, and by the same action, the movements of the indexes are effected through the wheel, a^3. Thus if the wheel, a^3, has 80 teeth, then the wheel, g, must have 16 teeth, and the pinion, g^1, 10 teeth; the wheel, g^2, 50 teeth, and the pinion, g^3, 10 teeth; the wheel, g^4, 40 teeth, and the pinion, g^5, 10 teeth; and the wheel, g^6, 60 teeth. The wheel, f, and the wheel, f^1, (on the axle, f^2,) being intermediate wheels for the purpose of causing the index hands to move in one direction, may have any convenient number of teeth. The whole of the parts which I have just described (excepting the index-dials and the handle, a^4) are enclosed in a case, to protect them from being interfered with, as also from dust, &c. To be able to ascertain exactly the true point of balance to which the steel-yard has been adjusted, I attach to it a small proof apparatus, composed of the parts marked $m\ m^1\ m^2$, $n\ n^1\ n^2$, and n^3. m is a light lever centred at m^1, which is connected at one end by a silk cord, m^2, to the end of the steel-yard, and at the other end to the bell-crank lever, n, by a cord, n^1; the bell-crank lever has its fulcrum at n^2, and its upper end, n^3, reaches to the graduated scale, n^4, and forms a pointer to it. When the steel-yard stands at its true point of adjustment, the pointer, n^3, should point to zero on the scale.

The improvements which have been just described may be used with a scale-beam instead of a platform, and in that case it will be sufficient to attach the scale to the shackle, S, and then proportion the other parts to suit this arrangement.

Mr. Alliott, states that by suitable intermediate gearing and shafting connected to the axle, A^1, two or more indexes may be applied to the same machine, and indicate at different and

moderately distant places the same results; neither the number nor distance of such indexes at all impeding or interfering with the correct working of the balance.

BEAUREGARD'S PATENT STEAM ENGINE.

[An English patent was granted on the 11th July last to M. Beauregard, "for improvements in generating steam, and in the means of obtaining power from steam engines." The specification will not probably be enrolled before the 11th January, 1849; but in the meantime we translate from *La Presse* the following account of the invention. The experiments of M. Boutigny, on which this invention is founded, were first noticed in this country in an article which appeared in our journal of the 13th July, 1844, and occupied afterwards a prominent place in the ingenious speculations of our much-valued correspondent, "A. H.," on "The Employment of Heat as a Motive Power," (*Mech. Mag.*, vol. xlvii.)—ED. M. M.]

The spheroidal state which drops of water assume when placed upon a heated metallic surface, is a fact now well known. Overlooked, or, at best, regarded as a matter of small moment, by the philosophers of the last century, it becomes suddenly, in the hands of M. Boutigny, a circumstance of immense importance,—gives birth to experiments the most singular, the most astonishing, and the most incredible of modern times,—raises up against the admitted theories of heat insurmountable objections, and disconcerts the most advanced science,—accumulates the elements of a new theory—furnishes the only reasonable explanation of those unforeseen explosions of steam boilers which occasionally spread terror far and wide,—and, lastly, promises to give, in the bold imagination of its author, a key to the impenetrable mystery of the formation of worlds.

We will not undertake, to-day, to describe all these marvels; we will not explain to our readers how M. Boutigny has been able to make ice in the burning bosom of a platina crucible heated to white heat; how, going yet further, the illustrious Faraday, following in the steps of the humble apothecary of Evreux, has succeeded, by the *tours de main* of his prodigious art, in fusing mercury in this same centre of heat, the most intense ever known. We will not narrate how we saw an enormous sphere of incandescent silver preserve for a long time its brightness and great heat in the bosom of a mass of water, which separated respectfully therefrom, and served it as a protecting envelope from cold. We will not enumerate either the beautiful and numerous laws which years of study and profound research have revealed to M. Boutigny, and which he has clearly formularized. We desire only to fix the attention of the reader on the following remarkable facts:

1. Water projected in small quantities upon an incandescent surface does not wet it, does not touch it, is not spontaneously vaporized; but, falling back on itself, as it were, it assumes a globular, or, what M. Boutigny terms, a *spheroidal state*, remains suspended at a short distance above, in the incandescent surface, and is slowly reduced to steam—fifty times slower than by boiling.

2. All these phenomena occur as soon as the temperature of the surface of the water reaches 200° (centigrade), and lasts until it descends below 142° (centigrade); the water then wets the surface, and is suddenly and spontaneously reduced to vapour with as much rapidity and abundance as gunpowder when ignited. For all other liquids, the necessary degree of temperature for the production of this phenomenon is as much lower as the boiling of the liquid is above that of water.

3. Water in the spheroidal state, and then even when in presence of an incandescent surface, does not attain 100° (centigrade), or the boiling point, but invariably remains at about 96°·5.

Such, in few words, are the fundamental facts demonstrated by M. Boutigny, and which, admirably comprehended by our young engineer (M. Testud de Beauregard), have led him to his present brilliant discovery. We will first faithfully describe the admirable machine which we saw at work yesterday, and afterwards its numerous advantages.

Let the reader place himself, in fancy, in front of a kitchen stove. On the right is a generator—a kind of Papin's inexplosible boiler, plunged in a *balneum mariæ*, which is filled, not with water,

but with molten lead, at a temperature of about 300° (centigrade). The bottom of the generator is of platina, and so moulded as to present a series of hollow hemispheres. A small feed-pump is placed behind, about the centre of the stove, which discharges at each motion of the piston a small quantity of water (say half a gramme for a machine of two horse-power) into the cavities of the hemispheres; the water passes into the spheroidal state, and thence into that of steam. The steam disengaged from the water at 96°·5 partakes at its generation of the enormous temperature of the generator. This sudden elevation of temperature, produced by itself, without absorption of latent heat, compensates a hundred-fold for the slowness of its generation by a considerable increase of tension. A safety-valve, placed in the centre of the generator, gives free passage to the surplus steam. We shall see further on that explosions are, theoretically and practically, impossible.

* * * *

A few days longer and a stationary steam-engine of 10 horse-power, fitted with this generator, will be at work in one of the largest foundries in Belgium. A locomotive on the same principle is also in progress of construction; and, by the care of Captain Chamier, a marine engine of 400 horse-power will be fitted to one of the largest of the ocean steamers.

* * * *

To return to our description, as the steam fills the spheroidal generator, it is conveyed by a steam pipe under the piston of an oscillating cylinder. But instead of allowing the steam to escape into the air after the piston has performed its stroke, and as is usual in high-pressure engines, M. Beauregard causes it to pass through a worm, enveloped in wet cloth, in which it is imperfectly condensed, after which it is brought, by a new method, into a state of perfect and absolute condensation. Against the back part of the furnace there is placed a cylinder in which a vacuum is created, once for all, in the following manner: The cylinder is closed by a stopper terminating in a metal rod; this rod is dipped in alcohol, then ignited, and plunged into the cylinder, whence the azote of the air is allowed to escape by a cock, which is then closed and a vacuum thus established. The atmospheric pressure upon the stopper keeps the opening tightly closed, and the vacuum which costs nothing, is permanently maintained for the following reasons: The steam from the hygrometric water which escaped from condensation in the worm is conducted towards the cylinder by a pipe, but through a second cylinder filled with chloride of calcium which substance retains it, and does not allow of its entry into the first cylinder, the purpose of the vacuum therein being to create the necessary draft.

From the foregoing description it will be seen that the steam is perfectly condensed, and there is nothing, absolutely nothing, to prevent the fresh emission of steam, and fresh stroke of the piston, &c.

Ah! if old Newcomen were living, of whose grand ideas on the subject of condensation this is but the realization, he would laugh in his sleeve (*rirait dans sa barbe*)—would glance triumphantly at the Watts and the Woolfs—and chaunt a pæan of victory.

And yet this is not all; there was yet another difficulty to surmount, another loss to be prevented. The steam is only condensed in the worm on condition of vaporizing without a quantity of water equal to that resulting from the condensation of the steam. So that what is gained on one side is lost upon the other. To utilise this steam, M. Beauregard brings it, by means of a draft or current of air, into the furnace of the generator where the heat decomposes and transforms it into hydrogen and carbonic oxide, two combustible gases which in burning transform themselves, so to speak, first into heat, then into vapour, and ultimately into motive power. The loss no longer exists, or is considerably diminished, and the machine is in its entirety as perfect as can be any work of man.

The following are the chief characteristics of this machine:

1. The water which falls in small quantities into the hemispherical cavities of the generator, passes into the spheroidal state, and then slowly into steam of a high temperature, which slowness of generation is amply compensated for by an excess of elastic force which will be sufficient for the working of the most powerful engines.

2. The steam thus generated passes under the piston and forces it up; after the stroke is made, the piston by its descent expels the steam into a worm where it is partly condensed by contact with a refrigerating surface.

3. What remains of hygrometric steam is forcibly drawn towards the vacuum cylinder, and absorbed half way by the chloride of calcium (which may be revivified by the simple and costless proceeding of exposing it to the heat of the furnace for a sufficient length of time).

4. The steam generated on the exterior surface of the worm is forcibly drawn into the furnace which it serves to feed. The circle of operation is then complete.

The only actual loss is the heat radiated by the sides of the furnaces, which M. Beauregard collects by a combination of reflecting surfaces to wherever it may be useful.

The admirable machine, which we saw at work for an hour, scarcely occupied the space of half a metre cube while the steam generator, which in ordinary machines would require 1,800 decimetres, occupied a space 300 times less, and yet the power as calculated by the inventor was 2 horse-power, and the pressure (tension) of the steam capable of being raised without the shadow of danger from one to five or six atmospheres.

These astonishing results were obtained with a minimum quantity of coal, and all those present at the experiment admitted that the results were quite at variance with all old theories and axioms.

In conclusion, we will terminate this long article by a brief notice of the incontestable advantages of this machine.

1. In the old engine there is an enormous radiating surface, and consequently an immense loss of heat. In the new one this surface is reduced in the proportion of 1 to 100; the furnace is small and loss of heat insensible.

2. In the old engine the steam is generated at 120° (at sea 105°) at a very feeble pressure, at the most one atmosphere, and capable of dynamic effect to the extent of about 3. In the new one the steam is generated at 96°·5, its pressure is 200 atmospheres and without danger, and the dynamic effect is at least 14.

3. In old low pressure engines the condensation was incomplete; a considerable portion of its power was employed to overcome the resistance of the used steam. In the new one the condensation is nearly absolute, and the maximum of useful effect constantly obtained.

4. In the old engines, the feed-water is charged with salts. The condensation necessitates the employment of an immense quantity of water—so much so, that at sea they are often obliged to blow off, with loss, water at 100°, because it is too saturated with salts. In the new one, the generator is fed with distilled water. The condensation is effected without any additional supply of water. There is never any necessity to renew the water which, running through the different parts of the machine, gives life to it, because this water, alternately vaporised and condensed, reappears of itself, abundant and pure.

5. In the old engine, loss of time through stoppages, is loss of money. The locomotives are often obliged to blow off the steam which cost much to generate, but which they could no longer contain without danger. In the new one, there is never a mass of water heated a long time beforehand—no tempestuous production or accumulation of steam—no fuel vainly consumed in anticipation of a journey; it is necessary only to maintain a small quantity of lead in a fluid state.

SANITARY MEASURES, NO. 2.—TRAPPING AND VENTILATING SEWERS.

Sir,—It is now more than twenty years ago since Mr. Cuff introduced his improvements in the construction of public sewers;* and fourteen years since the City Surveyor of Sewers officially denounced the innovation as dangerous: declaring that the introduction of sewer traps would be "highly detrimental," forming the sewers into subterranean receptacles for explosive gases, fraught with immediate death to any workman attempting to enter them, and with imminent peril to the adjacent buildings. It was also stated by this intelligent functionary, that the traps would present so much obstruction to the passage of water during heavy rains as to flood the houses

* Vide *Mech. Mag.*, vol. xii., page 60.

and lead to endless claims for compensation.* Opinions directly opposed to that of the City Surveyor, were obtained from men of science of high standing and of great authority on such a subject, the consequence of which was, that although the City Commissioners continued hostile to the plan of trapping the sewers *generally*, they so far relented as to apply Mr. Cuff's improvement where ever it was requested by the local authorities. In districts not under this controul, the improvement rapidly progressed, and the sewers throughout the metropolis are now universally trapped, to prevent the rising of noxious effluvia from the gulley holes; but, as a set off to the advantages thus ensured, *ventilators* have been inserted in the crown of the sewers, affording the freest possible egress to the carbonic acid, carburetted hydrogen, sulphuretted hydrogen, and other poisonous gases. So that while some pains have been taken to prevent the escape of noxious vapours at one place, equal provision has also been made for their exit at others. The inconsistency of these arrangements must be obvious. At the same time, it is evident that some method of getting rid of the imprisoned gases is indispensable. In a report by the late Dr. Birkbeck,† this was proposed to be effected by means of suitable tubes inserted at the highest points of the sewers through which the gases would rise, and were then to be ignited and burnt. The fallacy in this proposal, consisted in supposing the gases of the sewers to be always combustible. About a year ago Mr. Jabez Hare, of Nelson-square, Blackfriars-road, addressed a letter to Lord Morpeth, pointing out the absurdity of the present mode of ventilating sewers, and suggesting a peculiar application of an ascending column of heated air, for exhausting in an effectual and inoffensive manner the deadly exhalations of the sewers; the recent effects of which upon the unfortunate inmates of the *Justitia* convict ship at at Woolwich have forced conviction on the minds of men long sceptical as to the fatality of these exhalations.

A trial is being made of a mode of ventilating sewers by an ascending column of heated air, in Blackfriars-road, but under circumstances than can lead to no satisfactory result. The plan of Mr. Hare was comprehensive and economical—its application as above is local and expensive.

Mr. Hare is at this time before the Commissioners of Sewers—let us hope that good may result from his labours—but the fact is, that the whole question of sewerage, notwithstanding the progress of the last twenty years, stands sadly in want of consideration *de novo*.

I remain, Sir, yours respectfully,

WM. BADDELEY.

29, Alfred-street, Islington. Oct. 19, 1848.

* Ibid., vol. xxi., page 11.

† Vide *Mech. Mag.*, vol. xxi., page 12.

THE AURORA BOREALIS OF OCTOBER 18.

Sir,—The meteor of the 18th inst. having been very conspicuous and several features of the phenomenon perfectly developed, I forward to you such observations of it as could be taken with accuracy: they were made with an equatorial instrument and sidereal clock, from whence the altitudes and azimuths were deduced by calculation: the sidereal time is also converted into mean time.

The wind which had been blowing for several days from a north-easterly direction, increased considerably in force upon the morning of the 18th, and continued to blow briskly throughout the entire day, and also during the appearance of the phenomenon: at 8^{h}. A.M., snow commenced falling, the thermometer indicating $34^{\circ}\cdot 0$; the minimum temperature of the previous night was $29^{\circ}\cdot 8$ at an altitude of 45 feet above the earth's surface; a few snow showers occurred at intervals during the day, up to 4^{h}. P.M., and the barometer was steadily rising. My attention was first called to the aurora at $6^{h}\ 57^{m}$, when its light was so brilliant, that it was some time before I could persuade myself that the sky was free from cloud, as the contrast caused it to appear perfectly black: the usual dark segment was then visible from the circumference of which the streamers proceeded: 30° from the N. towards the W., or nearly in the magnetic meridian, there was a depression in this black arch, whose altitude was about 18° at the vertex:

the star Arcturas was seen within this segment at 6^h 10^m without the least diminution of its light. At 7^h 20^m 5^s, the western extremity of the arch terminated in a point of the horizon 75° from S. towards W., and the eastern 105° from S. towards E., it therefore inclosed a horizontal arc of 180° 7^h 36^m 4^s. A curious cone of auroral light rose from the magnetic north passing to α Andromedæ; this had a motion towards the W., for it soon after passed over η and β Pegasi, and at 7^h 41^m over α Aquilæ, consequently the direction of its motion must have been nearly *perpendicular* to the plane of the magnetic meridian: at 8^h 14^m 3^s the white arc passed over the seven stars of ursa major.

After this hour the meteor appeared to be declining in intensity, few streamers were seen, and the sky for some minutes was obscured by clouds. 9^h 28^m 1^s. the aurora was very brilliant, large red patches of light 14° broad with an altitude of 23° were in the magnetic W. and E.; those in the former quarter being most vivid, whilst streamers of a white colour were darting up from all parts of the horizon between these two points; at the same time an undulating motion was propagated in the direction of the axes of the rays up to the astronomical zenith, which was now perfectly scarlet, not from isolated streamers, but from a uniform crimson light; the white streamers kept increasing in length and with a pulsating motion converged to the magnetic zenith at 9^h 32^m, and forming the beautiful appearance of a crown, which at 9^h 37^m 1^s was perfectly developed, when the following position of the central point was taken: altitude 67° 31^m 4^s, azimuth from S. towards E . . . 26° 31^m 1^s. Nearly the entire sky was covered by the aurora for several minutes after the formation of the dome. The pulsations extended to within 17° of the southern horizon, bursting out in large sheets of white flame: it extended further south than the celebrated meteor of 1847, October 24, but at the same time was far inferior in brilliancy, although on the present occasion the moon was absent. The position of the corona was permanent and did not vary from the earth's rotation. 9^h 44^m 6^s. the arch terminated in the horizon 66° 15^m from south towards west. 9^h 47^m 9^s the aurora had attained great brilliancy in the N.W., the sky being a complete mass of flame with undulations passing in the direction of the streamers. In the W.N.W. the meteor was of a deep red colour, but not possessing so transparent a hue as in the earlier part of the evening; it remained in this state for about eight minutes and gradually faded afterwards till there remained nothing but an extra light in the N. with a few streamers; the pulsations, however, still continued, and seemed to burst out suddenly in the astronomical zenith, spreading over the sky like a large sheet of fire. Their appearance was very similar to that produced by a sea wave breaking and rolling along the beach: these undulations lasted more or less with some occasional intermissions until near 12^h 54^m, when it again assumed a very beautiful form, the rays extending to a much greater distance from the W. towards the S.; the whole sky from N.E. by N., to S.W. by W. was tinted with scarlet as far as the zenith, and was most brilliant in the magnetic E. and W. As in the case of the aurora of 1847, these red streamers were more stationary and of longer duration than the white, and did not partake of their undulatory motion. About 13^h 14^m it reached its maximum brilliancy, the rays converging to the magnetic zenith: rapid and frequent pulsations agitated this enormous mass of light to 5° south of the auroral pole, for ten minutes after which it quickly decreased in brightness, so that by 13^h 36^m it had almost disappeared, and scarcely a trace remained at 14^h. The thermometer stood at 34° the whole time, and the wind blew from N.N.E. Eighteen falling stars were counted up to 12^h, and it is worthy of remark that these are almost always seen during the presence of the aurora borealis: one with a train of 20° fell in a direction, the line of which produced, passed through the centre of the crown, and made an angle of 30° or 35° with the astronomical meridian. After dusk of the 19th, the aurora became again visible, and though the sky was tinged with red, it was never very conspicuous.

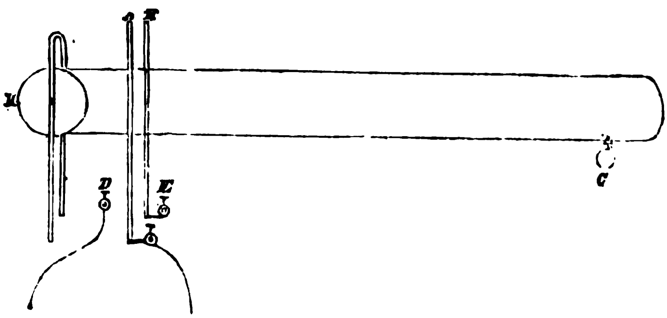
JOHN T. BARBER.

Etwell, October 20, 1848.

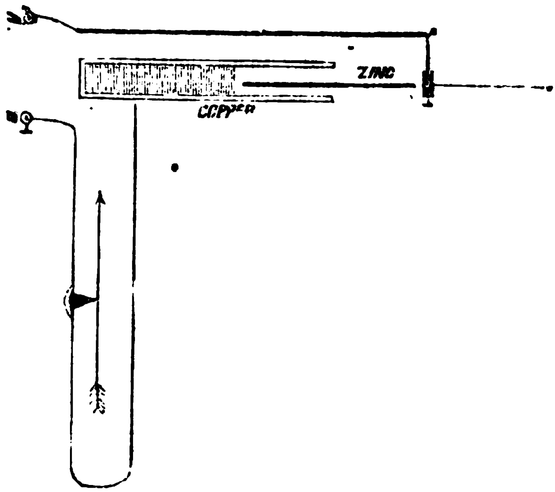
GALVANIC BLASTING.

Sir,—Though much has been written on this subject, the following observations may not be deemed unsuited to

your very useful Journal. In a lecture which I delivered in the Dublin Mechanics Institute, the usual operation of blasting by galvanic agency was described. I particularly noticed Mr. Martyn Roberts' method of attaching a string to the contact maker, so as to obtain the necessary distance without the same length of wire, which would require increased power of battery. I stated that when all is ready the assistant withdraws an ivory break, and after retreating to a safe distance, he gives the signal to the person who pulls the string. A member of the Institute, Mr. Thomas A. Dillon, 2, Caroline-row, has proposed an objection to this plan, and at the same time has suggested an ingenious remedy. He says, that when the ivory break is removed, the string might be pulled by accident before the assistant had retreated, and death might result. The remedy is novel and simple—let the *endless* cord pass over a pulley H; when all is ready, the person ties a *brass* ball, C, to the cord, which arriving at the brass pillory, A and B, establishes metallic contact between the battery and the cartridge attached to the screws, D and E; a mark on the endless band would indicate when the ball had nearly arrived at its destination, or the assistant could tie the brass ball to the endless cord at 2 or 3 feet from the brass pulley.



By such an arrangement, it would be impossible for an accident to occur. It affords me pleasure to give this to your numerous readers as the invention of a member of the Dublin Mechanics' Institute, and it is one of the proofs of the use of such societies. I may take this opportunity of stating, that *badly* prepared gun-cotton can be employed in this operation with great advantage. I have found that galvanic cartridges become useless if kept for a few weeks; this arises from the sulphur of the gunpowder acting on the delicate steel wire producing a break by corrosion. My plan consists in first covering the steel wire with a small quantity of badly prepared gun-cotton, over which I pour the fine powder, making a cartridge with paper not larger than half a finger: around this the proper quantity of blasting powder is placed, and the hole tamped with sand. There are two advantages in employing badly prepared gun-cotton: 1st, It can be made by any person with a mixture of equal parts of *common* nitric and sulphuric acids. 2nd, It ignites readily even with the wire below red heat, and invariably ignites gunpowder, which the best gun-cotton does not; and as it is not necessary for the wire to be red hot, one battery will discharge more than one cartridge, so as to produce simultaneous blasting. An efficient and cheap battery is zinc not amalgamated with salt and *hot* water, separated by porous cells from copper cans or *brass electrotyped* inside, which is better, as the surface is made rough, and there is no local action on soldered joints: eight or ten cells are sufficient for any blasting. I adopt the plan suggested by one of your correspondents, of testing the cartridge before blasting, so as to be certain that the steel wire is no broken. The following sketch represents



my apparatus, which should always accompany such a battery. A piece of zinc, two inches square, is lowered into a small copper vessel containing water and *a few drops* of acid; a wire from this copper passes over and under a magnet, and the cartridge is attached to the screws, A and B; if the steel wire be not injured a galvanic current deflects the magnet without heating the wire, as it is too weak. The importance of the subject, for human life is in question, may plead my apology for this lengthened description.

WILLIAM LOVER,
Lecturer on Physical Science
in the Schools of Dublin.

ON THE SIGNS + AND —. BY EX-REVIEWER.*

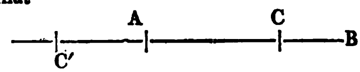
Mr. Editor,—The use of symbols instead of words to designate arithmetical operations has had a larger share in the creation of modern algebra than is generally seen: perhaps not less influence than the use of symbols instead of words to designate number had in the creation of arithmetic itself. They are steps of the same nature, are equally essential to generalisation, and have ended in results that completely harmonise. We first symbolised the particular number by a figure or figures; then symbolised number itself generally—by letters of the alphabet for convenience; and, lastly, we symbolised operations, either by contracting the name or part of the name, or by analogy to some fancied resemblance. Thus + is but a simplified form of the fanciful "&" (*et*), of the middle-age MMS.; " — " is the mark over "$\overline{\text{mns}}$" (*minus*) of the same period; "×" is the "cross" employed long anteriorly, "to prove multiplication;" "÷" is the representation of a fraction in

* It is due to our esteemed friend that we should point attention to the date of his present communication. It came to our hands a day or two after the receipt of the able series of papers on the same subject, which has recently appeared in our pages from the pen of "A. H.," and before any portion of that series was published. We thought it right to keep it back till the publication of those papers was concluded; and we now insert it with the approval of the author in precisely the same state in which it was sent to us. "A. H.," it will be remembered, has laboured hard to establish the independence of algebra of arithmetic, or to speak more correctly, perhaps, that both have but one common symbolical basis; our "Ex-Reviewer" takes a view of the subject nearly the opposite of this, and supports it with his usual vigour and dexterity. The opponents, it must be confessed, are well matched; and the arguments on both sides suggestive of much curious and interesting speculation.—ED. M. M.

which the numerator and denominator represented the dividend and divisor in their appropriate places for actual operation; "=" are the two "gemowe lines" of Robert Recorde, chosen, he says "because noe two things can be more equal;" and "$\surd$ is a modification of the letter *r*," used as the initial of the word "radix." In the same way we may trace the history of our "symbols of operation," even down to their most modern state.

The symbol of operation never appears but as a *direction* to perform the operation signified. It hence always belongs to an unfinished process of investigation. When the conditions are given in actual numbers, the solution can always be effected either wholly or approximately; and the symbol disappears altogether. The introduction of general symbols, so as to represent in one symbolical investigation the rule for all solutions of the same kind, leads to a result which is merely *directive* of the simple processes by which in all particular numerical cases, the numerical result which is sought shall be found. When the directed processes are all compatible with each other, we can in all these particular cases eliminate the sign by performing the operation which it ordains. This, however, is a very confined view of the functions of algebraic research—that of a mere schoolboy.

It was soon felt to be necessary to carry on a long series of operations, (many of which involved complicated expressions which themselves essentially involved the signs of operation) that would demand inquiry into the effect of combining these signs amongst each other. Thus if it were required to multiply $a-b$ by $c-d$, it was necessary to inquire what *form* the product in terms only involving simple factors would take, without making any hypothesis respecting the numerical values of a, b, c, d. There are men of the most profound learning in our own day, who think that the fourth term of that product, $-b \times -d$ $(=+bd)$, though assumed and proved under specific relations of the numbers, is only assumed but not proved as a general logical deduction from the principles of arithmetic. I, myself, believe that no proof having greater validity than that of "Iatromathematicus," has ever yet been given. (See *ante*, p. 200.) The idea is precisely that with which the early Italian algebraists must have been familiar: the *transfer of a quantity from one page of the "ledger" to its opposite*—the fact of multiplication being a succession of subtractions of the same quantity, being also kept in view. It is the best illustration we yet possess, except the verification as to *form* which is afforded by comparing the square of AC viewed as that



of AB − BC with the second power of $(a-b)$. It would in geometry, however, find no visible analogy when BC > AB, or $b>a$: for then in reality the condition would only appear under another form: For if $b>a$, than $a-b=-d$, and $(a-b)^2 =(-d)^2$: whilst, if C be to the left of A (as at C′) the geometrical signification altogether fails to be intelligible.

So strongly was this difficulty felt by the earlier algebraists, that a negative quantity was naturally rejected by many of them; and when such values made their appearance as roots of an equation, they were called "false roots" and "illusory roots." Many, however, viewed this matter otherwise, and boldly ventured upon the generalisation that "− × − really does produce +, whether we are able to prove it logically or not;" and whilst others spent much labour and wasted great ingenuity in settling the theorem on a satisfactory basis, these more ardent minds trusted to the perfect consistency of all the results obtained by means of it, as the best proof that could be given of its absolute truths. The proof is that of induction; and this theorem under such a view has all the evidence (*and of precisely the same kind,*) that belongs to the law of gravitation.

I do not know that any one has expressed distinctly before Cauchy in his (*Cours d'Analyse*) what seems to be implied in a great number of writers during the last century and a half:—that when +, −, or any other symbol of operation, is prefixed to a literal quantity, and that quantity when modified is directed to be subjected to another operation, the first-named symbol takes the same character as an adjective or adverb in common language. It is no longer the quantity which designates

number which is to be operated upon, but the different entity which results from the modification of the number by the first symbol. Thus, $\sqrt{a+b}$ can always be performed in numbers in two successive operations; so also can $\sqrt{a-b}$ when $a>b$. When, however, in the last expression $a<b$, the second operation *cannot be performed*,—nor yet in strictness without the conventional signification above spoken of, which renders $-d$ a real number. We often mistake the object of an inquiry by means of algebra: viz., the *form of the result* of an inquiry, for the *mere number* which fulfils the limited and specific conditions laid down. No result is available for strictly numerical purposes, except in terms of such modified numbers as may be compatible with the conditions we impose upon them. If we ask for an answer in plain, positive numbers, such as we consider them in common arithmetic, the thing will be impossible when the numerical conditions give $-d$ as the result. Again; if we consider $+d$ and $-d$ to be the only admissible modified forms of number, then $\sqrt{-d}$ is excluded, and we again may have impossible conditions denoted amongst our data by the result. It is not usual to call $-d$ a number in our ordinary verbal expressions, but it is *now* always treated as one virtually; and its interpretation is always given in some shape expressive of modification from the quantity $+d$. In short, + and − are *practically* treated as adjectives are treated in language.

It has long appeared to me that this view of algebraical (or general) symbols of number, as "affected" by symbols of operation, is not only a convenient, but also a strictly philosophical one. It is likewise a perfectly intelligible one to the student—a matter of great importance. I am not, however, desirous of entering into the "vexed Bermoothes" of "the permanence of equivalent forms," or any of the theories by which it is attempted *logically* to establish those symbolical generalisations which appear to me to be mere *inductions* from "arithmetical algebra." I fear, indeed, that the attempts which have been made to throw over the processes of algebra an appearance of logical severity to which the arguments have no real title, has been productive of serious mischief—at all events, of great indistinctness in the minds of students, which few have the perseverance or the time to seek to elucidate.

Horne Tooke's theory of language was—that all words were ultimately reducible to the noun and verb; and from what has been stated above, his views are confirmed in a remarkable manner by that most perfect (imperfect as it is) of all languages—that of symbols. Perhaps, on the other hand, the structure of ordinary language itself may offer some useful suggestions towards a better mode of mentally reading the language of symbols. The history of the two systems will, I have no doubt, become ultimately analogous—with, possibly, more of identity than analogies in general possess. They are, in fact, more than analogies; for they flow from the same common principles.

If, then, we view all algebra as tending to the discovery of *unmodified* numbers that shall fulfil the conditions imposed by a problem, there can be no doubt that your able correspondent—"Iatromathematicus"—is fully borne out in his views. But is this the object attained or aimed at by algebraical science?* One thing is clear—that had it been so, physical science would now have been in a very different state from that in which we find it. We should, indeed, have possessed such an algebra as Maseres, Frend, and Carnot, would have deemed perfect; but we should not have had the algebra which we do possess, and which enables us to extort from nature her inmost secrets. It is on this account that I demur to the acceptance of the

* It will be remarked that I have usually preferred the term "algebraical" to "analytical." The latter term is only *accidentally*, not *essentially* applicable to the symbolical system. Many of the processes of algebra are *synthetic*; though incomparably more in the present form of the science are analytical. The term was introduced by D'Alembert; but it surely will not be contended that an entire branch of science should be designated by an accident, especially when another and a different branch is strictly and properly designated by the same name. Analysis belongs to geometry as well as synthesis; and synthesis belongs to algebra as well as analysis. They are both general methods, and altogether independent of the particular subjects and the particular machinery through which they are brought into play. The writers of the *Encyclopédie* vitiated the language and the philosophy of mathematics as much as they improved its algebraical processes.

doctrine that symbols are to be confined to the mere arithmetical interpretation which their origin would seem to impose upon them.

At the same time, I candidly confess, that for many of the "truths" of algebra, I have no better proof to offer than that of *induction*. A single unexplained exception to the truth, in the remotest of its applications and consequences, would, I am willing to admit, overthrow the theory of algebra; but show me one! As far as logical rigour is concerned, the advantage is wholly on the side of geometry, as compared with algebra; but the evidence of the latter, though of a different kind, is not less clear and convincing than that of the former. The great ground of the excellence of geometry as a *discipline*, is its logical rigour; that of algebra, is its *power* in physical and semi-metaphysical researches.

I remain, Sir,
Your Ex-Reviewer.

September 20, 1848.

MR. L. D. B. GORDON'S PATENT UNDER-LAP JOINTED RAILS FOR RAILWAYS.

[Patent for England dated May 9th, 1848; Patentee, L. D. B. Gordon, Esq., C.E.*]

Hitherto, where two lengths of rails meet, the joint has been made either a simple butt-joint, or a perpendicular overlap joint. Several inconveniences arise from these kinds of joints. When from imperfect packing, (after heavy rains, or with bad ballast), the sleepers become unsupported and sink under the locomotive and carriages, the weighted rail cants the chair, and in spite of the best chairs and keys, the rail next in advance of the wheel rises, more or less. If the joint be exactly in the middle of the chair, the dislocation is less in amount, but it will be found that such a position is the *exception* to the general state of railways having cross sleepers. The disadvantages of this imperfection in the joint are palpable. It is the *origin* of the oscillatory motion of the locomotive and carriages on railways—of the sinuous or serpentine motion which commonly ends in running off the rails. It is the source of the great amount of *resistance* to locomotion, still remaining after that arising from the friction of axle and periphery, and the air's resistance are taken into account, and which experiments show to be about 25 per cent. of the whole; and consequently it must be a main cause of the wear and tear of wheels, springs, and several of the working parts of the locomotive, as well as of the expense of maintaining the rails in their proper position in the chairs: for, the impact of the wheels on the rails, at the joint, is the cause of their travelling through the chairs (as it is technically termed) in the direction of the train's motion.

By the patent underlap joint of Mr. Gordon, which we are about to describe, these defects of the butt-joint will be very much, if not entirely divided. When such sinking as we have spoken of takes place at the joint-sleeper, provided the rails have the under-lap joint, *it is impossible for the unloaded rail to rise above the loaded rail under any circumstances likely to occur.*

Several examples of this under-lap joint are given in Fig. 1, 2, 2*a*, 3, 3*a*, 4, 4*a*, 5, 6, and 7. The following is Mr. Gordon's own description:

"In figs. 5, 6, and 7 is shown the principle of introducing a fitting piece of hoop, or other iron, so as to bring the ends of the rails to the same level when they have been imperfectly cut, or when the bearing surfaces have become worn. The figs. 3, 3*a*, and 6 show the joint I recommend for double-headed rails, when these are to be turned over so as to make use of the other side of the rail when one has become damaged by wear. Figs. 1, 2, 2*a*, 4, 4*a*, 5, and 7 refer to the joint to be cut for single-headed rails. Figs. 1, 2, 2*a*, 4, 4*a*, represent the joint cut so that a stop may be introduced into the chair to prevent the rails travelling through the chair.

The under lap jointed rail is stated to be also cheaper than any other now in use. The rail, as may be seen from the figures, may be of any section preferred by the engineers.

Mr. Gordon's present patent comprehends also several other improvements in railways, his description of which we subjoin.

"My second improvement in railways consists in a peculiar manner of adapt-

* Agent for England, Mr. W. D. Starling, No. 37, Old Broad-street, London.

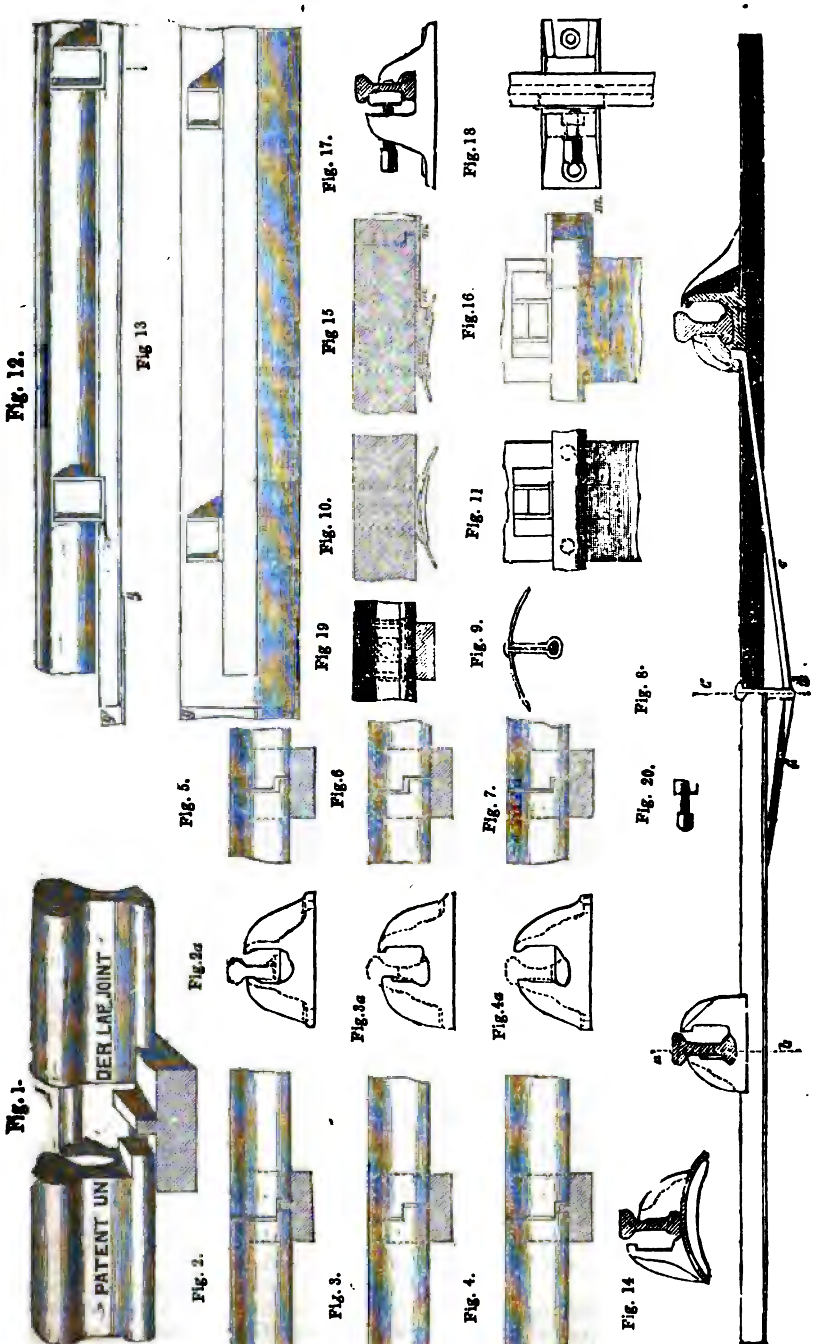


Fig. 1.
PATENT UNDER LAP JOINT
Fig. 2.
Fig. 2a
Fig. 3.
Fig. 3a
Fig. 4.
Fig. 4a
Fig. 5.
Fig. 6
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11
Fig. 12.
Fig 13
Fig. 14
Fig 15
Fig. 16.
Fig. 17.
Fig. 18
Fig 19
Fig. 20.

ing thin sheets or plates of malleable iron to form either cross-sleepers or longitudinal bearings for supporting the rails. For this purpose I take a plate of iron of sufficient length to form a sleeper of from one-sixth to one quarter of an inch in thickness, and suitable width, say from ten to sixteen inches, and punch a hole in the middle as at *c*, fig. 8, and two or more holes at the parts where the chairs are to be fixed, as shown at *e f*, fig. 8. I then bend the plate into a cylindrical arc, having a radius of from 18 to 36 inches, or so that there is a concavity of from 1¼ to 2¼ inches, according to the width of the plate, as shown by the figures.

"Having prepared moulds of the two chairs, at the required distance apart, I place the iron sleepers with the corresponding holes over the moulds of the chairs, which I then cast, using enough metal to form a thickness of half an inch or so of cast iron inside the sleeper, and in this manner I form an inseparable connection between the chair and the sleeper, no bolts or rivets being required to fasten them together. I adopt the following mode of strengthening the sleeper by a brace or braces, marked *c c*, in fig. 8: the centre hole in the sheet iron receives a malleable iron "ring post," *c*, *d*, which is fixed in its place by casting round its end a button of iron, *c*, shown at fig. 9; the brace must be put in its place before the metal is cast, and is fixed by the metal of the chair, as shown at fig. 8, as one of many ways of doing it. Fig. 10 is a longitudinal section through the rail, chair, and sleeper. Fig. 11 is a view showing the chair on the sleeper and the rail in the chair.

"Fig. 12 is a side view of a longitudinal sleeper or bearing, with chair attached to it, according to my invention, with a rail in the chairs. Fig. 13 is a plan of it, and fig. 14 a section through the chair. As the length of plates is limited, the manner of insuring an uniform strength of the bearing is shown at *g g*, figs. 12 and 13. A plate of the same strength as the bearers, and about 18 inches in length, is bent, so that its convex side fits the concave side of the bearers, and extends an equal distance under the ends of them.

"For the purpose of keeping the rails to the gauge when longitudinal bearings are used, I cast a hole in the joint chair, and drop into it one end of a rod of iron, bent at right angles, and the other end also bent, into a similar hole, in the chair opposite.

"My third improvement consists of a mode of strengthening or fastening the rail at the joint by means of a trough or other girder of malleable iron. Fig. 16 shows a plan of doing this: the chairs next the joint are made with a projection at one side, and the sleepers are 2 feet 2 inches, or so, apart. The trough girder, *m m*, rests on the projection of the chairs and supports the ends of the rails, as shown in fig. 15, which is a longitudinal section.

"My fourth improvement consists of a mode of fastening the rails in the chairs. Fig. 18 illustrates this. I make use of a screw for fastening the rail in the chair; it works through a nut which fits into a recess, cast in the chair; there is a slot for the purpose of allowing the screw and nut to be put in or taken out without unscrewing the nut. The screw and nut are shown at fig. 20. Fig. 17 is a section through the chair, showing the screw in its pressing against the wooden key or other elastic medium; a thin piece of iron being interposed between the end of the screw and key. When wooden keys are used, I prepare them in this manner: I make a varnish of any of the drying oils by boiling it for several hours with an addition of red lead, equal to from one-sixteenth to one-twentieth of its weight. When the oil has been thus prepared, I maintain it at a temperature of about four hundred and fifty degrees Fah., and by steeping the keys in it they become so thoroughly impregnated with the varnish, that their hygroscopic quality is destroyed (though their elasticity is unimpaired,) and thus they do not alter in bulk under the influence of moist and dry seasons."

"MECHANICAL TRUTHS, LOGICAL FALSEHOODS." — THE "TRUTHS" DOUBTED, AND COMMON SENSE VINDICATED.

Sir,—Common sense, *unfettered* as well as unaided by the rules and dogmas of "science," often establishes conclusions at variance with them;—hence it is that things have been accomplished by practical men that have been previously pronounced impossible by men of science, who not uncommonly overlook the un-

soundness or incompleteness of the data upon which their reasoning is based, and believe they have arrived at truth when they have assured themselves of the logical accuracy of their argument.

Perhaps there is no more fruitful source of these discrepancies between facts and theories, than the misuse or the misapprehension of the terms used in scientific discussion. Science, unwilling to acknowledge itself *ignorant*, as, with our imperfect intellect, it must ever be on many subjects, frequently raises a cloud of wordy dust, to blind the eyes of the unscientific, or writes up a "*ne plus ultra*," to deter them from further research in a direction in which its own investigations have proved ineffectual. Of the latter class is the phrase, "matter is infinitely divisible," with which my townsman, Mr. Pitter, premises his argument in your last Number. Now, although science may advance this as an axiom, because it has failed to discover the ultimate condition of matter, yet it *may* be possible to arrive at a more satisfactory conclusion by the simple exercise of common sense. With all due deference, therefore, to science, common sense imagines that the word "infinitely" is not used correctly in the sentence in question, unless it be made to bear a signification which does not usually attach to it. If the meaning of the sentence be, "that matter is susceptible of *extremely minute* subdivision," then the assertion cannot be controverted because experience proves it; but if the words have their plain and ordinary meaning, the correctness of the dogma which they express may then be fairly disputed.

It may be, as doubtless it is, a truth, that matter may be divided and subdivided to an extent beyond the reach of ordinary conception; but this, surely, does not demonstrate that the process may be carried on "*ad infinitum*." Such an idea, if admitted, tends to absurdity and error, as Mr. Pitter has shown; and whatever *ends* in error, must, if the inductive process be correct, be *based* in error; for truth, truthfully construed, cannot produce anything but truth.

Without entering upon the merits of Mr. Pitter's suggestion, it may be sufficient for my present purpose to make a remark or two upon the use of the term "infinite" in the case in point.

It appears to be the custom in matters of science, when an investigation has been carried as far as may be convenient or possible to the investigator, without arriving at a definite result, to write down the subject, whatever it may be, as infinite, or without end. Now, however far this "conclusion in which nothing is concluded" may hold good with regard to abstract ideas of time, space, &c.,—such, by the way, as those which Mr. Pitter has adduced in his first illustration of a *material* "law,"—it is doubtful, to say the least of it, if it will apply at all to matter. For, if aggregation be the perfect contrary of disintegration (which is, perhaps, a better term than division), then, if the aggregation of a certain number of particles will constitute a certain mass, the disintegration of the same mass will produce a certain number of particles, and the fact that the exact number of particles cannot be known by reason of their extreme minuteness, does not invalidate this conclusion any more than it establishes the dogma of "infinite divisibility."

The existence of anything as a whole, which is a definite result of aggregation, is presumptive evidence that disintegration also leads to a definite result; and surely it must be more honest to say at once, that that result is beyond the reach of human reason, as at present developed, than to mystify the subject by asserting that "matter is infinitely divisible," which is neither self-evident nor demonstrable.

Mr. Pitter's communication supplies another instance of the misuse of an important word:—it states that "if two lines *eternally* approach each other they must meet at some period." Now if an *eternity* be the duration of the approach, when will the period of contact occur? It is evident that the word "eternally," as used here, is intended to signify "for ever *and a day*," and that the terms employed in discussing the *exact* sciences must in some instances be qualified, *cum grano salis*, before they exactly suit the palate of common sense.

I am, Sir, yours, &c.,

J. Rock.

Hastings, Oct. 23, 1848.

ON THE CONSTRUCTION OF THE OVAL OF FIVE CENTRES, AS USED IN THE ARCHES OF BRIDGES, ETC.

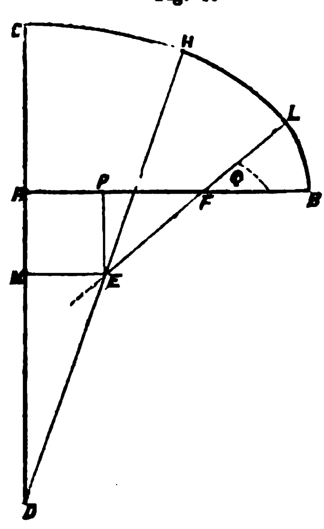
Sir,—The many and signal advantages of the oval form of curve in the construction of bridges and other arched structures, are well known to engineers, practical builders, and working mechanics, and would, I believe, be more generally employed by all, were the proper arrangement of its various members, and its practical construction, both on the paper and the platform, rendered more simple and intelligible. The difficulty of describing accurately a large ellipse upon the platform, and the more than difficult operation of properly arranging the positions of the arch-stones, forbid, in a great measure, its general use, while the advantages of its form are admittedly desirable; but the oval of *five centres* may be made to combine all the strength, beauty, and amplitude of water-way, incident to every other form while its linear construction upon the plan and platform, and its actual erection upon the centres, may be rendered as simple and facile as that of a semicircular or segmental arch.

I know of no rules, either written or oral, which point out even an approach to a general method of construction for oval curves, at once applicable, without investigation, to the various cases which usually arise in practice; and although the man of science or extensive practical experience, may feel no difficulty in designing an oval curve to suit any particular span and rise, there can be no doubt but that the proper and just adaptation of the lengths of the various arcs of which the oval is composed, the number of degrees contained in each, and the ratio of the radii, are matters which require considerable thought; and admitting, as they do, of infinite variation, and involving abstruse and tedious calculation, the question, in its scientific form, presents to the practical builder anything but a seductive appearance. Having had occasion lately, in the course of practice, to investigate this subject, and having preserved for official use such points as appeared to me of practical value, I beg to subjoin a few, which I believe will be found highly useful and convenient to any person who may have occasion to use an oval curve, either as the arch of a bridge or for other purposes.

Physico-mathematical writers have discussed the properties of the oval curve variously, holding in view, however, one common object, namely, to express the relations which obtain between the span, rise, number of degrees in each arc, and the ratio of the radii, under certain imposed conditions. The conditions best suited to practice are, perhaps, that the arcs, estimated from the springing towards the crown, should receive an uniform *decreasing* ratio of curvature, which, of course, depends upon the ratio of the radii; while the lengths of the arcs are made to *increase* in a given ratio. Now, as the ratio of the radii, and that of the arcs may be infinitely varied within certain limits, it evidently follows, that for any particular case, one of the radii, its ratio to the others, and also the ratio of the arcs, must be *assumed;* and upon the judicious exercise of the judgment in making these assumptions, depends the perfection of the resulting curve.

Adopting the usual method of investigation, let the half span, AB (fig. 1), be denoted by a, the rise AC by b, the ratio of the radii by x, the ratio of the arcs by y, the number of degrees in the arc at the springing by ϕ, and the radius of this arc by r. Also let the conditions

Fig. 1.



imposed be such that the radii, FB, EL, and DH, shall be represented by r, rx, and rx^2 respectively; and the number of degrees in each arc by ϕ, $\phi\frac{y}{x}$, and $\phi\frac{y^2}{x^2}$.

Then it follows, from the properties of the figure, that

$$\phi+\phi.\frac{y}{x}+\phi.\frac{y^2}{x^2}=90^\circ.,$$

from which we get

$$\phi=\frac{x^2}{x^2+xy+y^2}.\,90^\circ.\dots\dots\dots 1.$$

Draw EP perpendicular to AB, and EN perpendicular to AD; then

$$PF=EF.\cos.\phi=(rx-r)\cos\phi;\text{ and }EN=AP=$$

$$DE.\cos\left(\phi+\phi\frac{y}{x}\right)=(rx^2-rx).\cos.\left(\phi+\phi\frac{y}{x}\right).—$$

$$\therefore AB=r+(rx-r)\cos.\phi+(rx^2-rx).\cos\left(\phi+\phi\frac{y}{x}\right):—$$

Wherefore

$$a=r.\left\{1+(x-1)\cos.\phi+(x^2-x).\cos.\left(\frac{x+y}{x}\right).\phi\right\}\dots\dots\dots\dots 2.$$

Again,

$$PE=AN=EF.\sin.\phi.=(rx-r)\sin\phi;$$

and

$$ND=DE.\sin\left(\phi+\phi\frac{y}{x}\right)=(rx^2-rx).\sin\left(\phi+\phi\frac{y}{x}\right);$$

but

$$AC=DC-(AN+ND)=rx^2-(rx-r)\sin\phi—$$

$$(rx^2-rx)\sin\left(\phi+\phi\frac{y}{x}\right);$$

wherefore,

$$b=r\left\{x^2-(x-1)\sin\phi-(x^2-x)\sin\left(\frac{x+y}{x}\right).\phi\right\}\dots\dots\dots\dots 3.$$

Equation (1) gives the means of dividing the quadrant BHC into such parts as will correspond to the values we may *assume* for x and y, which values may be varied at pleasure within practical limits. Equation (2) shows the relation which obtains between the half span (a) and the springing radius (r), in terms of the assumed values of x and y, and the angular quantity ϕ; so that before the equation can be solved, another assumption must be made either for a or r. In like manner equation (3) gives the relation between the rise (b) and springing radius (r), but requires no new assumption if equation (2) be first determined.

The foregoing investigation is perhaps the most simple form in which the problem can be generalized, and from those formulæ I have calculated the following table which I believe will be found to include within its limits every variety of oval required in practical operations, from the largest arch of the most celebrated bridges, to the smallest ornamental curve of this form used in the decorative art. As will be seen by inspection, the table ranges from the superior limit of the rise $=\frac{1}{2}$ the span, to the lower limit of the rise $=\frac{1}{4}$ the span, descending by small differences, and giving in its course the data for 17 *unit ovals* of various forms calculated to a half span $=$ unity. The form of curve being fixed upon for any particular case; we have therefore only to multiply the given half span by the linear quantities in the table, and the result will be the corresponding lines required for construction.

It may now be well, by way of example, to construct an arch from the table, which will serve to show the method to be followed in all other cases. Let it be required to construct the curve, No. 15, upon a span of 60 feet. If the tabular linear quantities for this curve be multiplied by the given half span, the following results will be obtained, viz., 30 ×

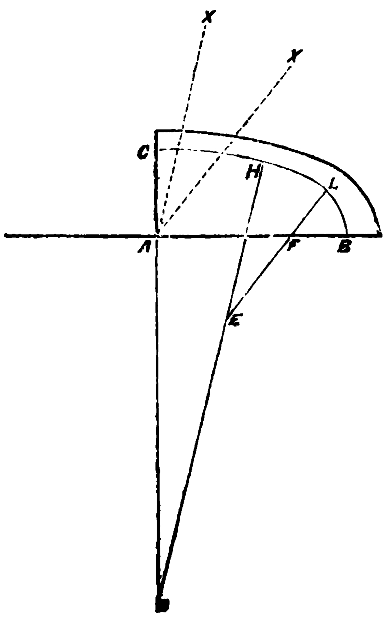
TABLE CALCULATED FOR THE CONSTRUCTION OF OVALS OF FIVE CENTRES.

No.	Ratio of Half Span to Rise.	Rise.	Crown Rad.	Middle Rad.	Spring-ing Rad.	Crown Arc. (Half.)	Middle Arc.	Spring-ing Arc.	Length of Spring-ing Arc.	Values of x.*
						D. M.	D. M.	D. M.		
1	1.085	.921	1.051	.936	.830	38.54	29.12	21.54	.317	1.125
2	1.171	.854	1.109	.887	.709	36.36	29.40	24.44	.306	1.250
3	1.254	.798	1.174	.856	.623	32.42	29.55	27.33	.299	1.375
4	1.357	.737	1.244	.829	.553	30.00	30.00	30.00	.289	1.500
5	1.422	.703	1.321	.813	.500	27.38	29.56	32.26	.283	1.625
6	1.504	.665	1.404	.802	.458	25.30	29.46	34.44	.278	1.750
7	1.585	.631	1.491	.795	.424	23.36	29.31	36.53	.273	1.875
8	1.665	.601	1.585	.793	.396	21.54	29.11	38.55	.269	2.000
9	1.743	.574	1.683	.792	.373	20.20	28.50	40.50	.265	2.125
10	1.821	.549	1.788	.795	.353	18.57	28.25	42.38	.263	2.250
11	1.898	.527	1.894	.797	.336	17.42	27.59	44.19	.260	2.375
12	1.974	.507	2.009	.803	.321	16.32	27.33	45.55	.258	2.500
13	2.047	.489	2.126	.810	.308	15.29	27.06	47.25	.255	2.625
14	2.120	.472	2.250	.818	.297	14.33	26.37	48.50	.254	2.750
15	2.191	.456	2.376	.826	.287	13.40	26.10	50.10	.252	2.875
16	2.258	.443	2.513	.838	.279	12.51	25.43	51.26	.251	3.000
17	2.325	.430	2.649	.848	.271	12.07	25.16	52.37	.249	3.125

* y being constant, and $= 1.500$.

$\cdot456 = 13\cdot68 =$ rise; $30 \times 2\cdot376 = 71\cdot28 =$ crown radius; $30 \times \cdot826 = 24\cdot78 =$ middle radius; $30 \times \cdot287 = 8\cdot61 =$ springing radius. Now take AB (fig. 2) = the half span, and AC perpendicular to AB = the rise; produce CA and make CD = the crown radius, and make BF = to the springing radius. From the centre A lay off with a protractor the angles given in the table, namely CAX = 13° 40′, and XAX′ = 26° 10[1]; parallel to AX, and through the point D draw DH; and parallel to AX′, through the point F, draw LE intersecting DH in E; D, E, F, are the required centres, and DC, EH and FL are the required radii of the oval. The other half arch can be constructed in a similar manner.

Fig. 2.



The length of the curve CHLB is now required, and may be found as follows:—Let L denote the whole length from the springing to the crown, and l the length of the arc at the springing; then from the constant ratio assumed for the arcs we have generally,

$$L = \left(l + l.\frac{3}{2} + l.\frac{9}{4} \right).—$$

But the tabular value of l being given, we have only to multiply it by the given half space, and l is found, which for the curve above constructed is $30 \times \cdot252 = 7\cdot56$; and the foregoing formula becomes in this case

$$L = \left(7\cdot56 + \frac{7\cdot56 \times 3}{2} + \frac{7\cdot56 \times 9}{4} \right) = 35\cdot91,$$

the length of the intrados from the springing to the crown. It may be observed that the outer curve or extrados in fig. 2 may be found in the same manner as shown for the intrados. In an arch of the magnitude stated above, the bed of the springer at B may be taken at 5 feet; if therefore 35 feet be taken as the half span of the extrados, and this curve be calculated as the intrados has been, it will give the depth of the key-stone 2 feet 3 inches, which perhaps will be thought sufficient.

I shall now close this paper with one or two remarks as to the further use of the table. Suppose it were required to construct upon any given span an arch of the form of those used in the following bridges; we have only to take the ratio of the half span and rise of the existing bridge, and having sought this ratio in the second column of the table, it will indicate the arch required. Thus,

Blackfriars Bridge, London, — half span ÷ rise = 50 ÷ 40 = 1·250, found at No. 3 of the table, which is the curve required.

Bridge of Orleans, France, — half span ÷ rise =

$$\frac{53\cdot5}{30}1\cdot783$$

found at No. 9 of the table.

Bridge at Nantes, France,—half span ÷ rise =

$$\frac{64}{38\cdot5}1\cdot662$$

found at No. 8 of the table.

In the same way it will be found that a very near approximation to the curve of the celebrated bridge of Neuilly, near Paris, will be found at No. 13 of the table. T. SMITH.

Bridgetown, Wexford,
October 2, 1848.

GENERAL SIR HOWARD DOUGLAS'S "PROTEST."

Sir,—So much depends upon the various tastes of men, and particularly of scientific men, that it would be difficult to say, with any degree of certainty, whether "A Constant Reader," who writes in page 369 (*ante*), will feel disposed to pronounce your correspondent Mr. Smith's last letter very "*amusing*;" but as it appears he reads for "instruction" and "information" as well as "amusement," I would suggest that he shall be no loser in time or trouble, by taking up some elementary work, and carefully perusing the principles glanced at in Mr. Smith's communication, page 400, as the "Books" seem all to favour his views of the disputed point.

I am one of those who would be always disposed to attach great importance to any document bearing the name of such high authority as Sir Howard Douglas, and am perfectly willing to acknowledge the advantages which must arise from the publication of the "Protest," and the discussions to which it has given birth; but it appears to me not less important to recognise the merit of a man who detects a "*fundamental error*" in a document of so much public interest as that of the "Protest," and by a scientific exposition, to which none can fairly object, prevent *pro tanto*, the very errors of distinguished men from passing current as a matter of course.

I have looked carefully into the works of several authors upon hydrodynamics, and it is plain they all agree in showing that if an inclined plane move in a liquid at rest in the direction of its axis, or if the plane be stationary, and the fluid move against it in that direction, the impulse in the direction of the motion (which in the case of a breakwater is horizontal), varies as the *cube* of the sine of inclination. Every objection to this general law founded upon the variable length or height of the plane, is untenable, as by the use of the sine of inclination, the *ratio* of the length of the plane to its height, however they may vary, is reduced to the ratio of unity to the sine of inclination, and the law is rigorously true under all possible circumstances. *Hutton by Ramsay*, (page 590,) is particularly plain upon the point, where it is clearly shown that the whole quantity of fluid which strikes the plane is as the sine of inclination; the resistance perpendicular to the face is as the square of the sine of inclination; and that the resistance in the direction of motion varies as *the cube* of the sine of inclination; which is certainly what has been contended for by Mr. Smith, and is unquestionably at variance with the note annexed to Article II. of Sir Howard Douglas's Protest.

I am, Sir, yours, &c., RATIO.

[We reserve for next week a letter from "An Old Engineer," which differs somewhat from the preceding communication.—ED. M. M.]

Sir,—I am glad to find that the publication in your columns of my description of a new electro-motive machine has attracted the attention of at least one who has "for several years paid considerable attention to the subject." Any disappointment I might feel at finding the principle I have suggested fairly proved to be worthless for the end proposed, would be much more than counterbalanced by the pleasure of seeing the light of truth brought to bear more clearly than it has yet done, on this curious and important subject. I therefore most cordially shake hands with "F. F.," as is the custom with all honourable opponents, and hope that neither of us will lose sight of this important object through a preconceived preference for any favourite scheme of our own.

"F.F." institutes a comparison between the results given by the model constructed by me, and those he theoretically deduces from a machine on the common rotary principle. Now, it is scarcely fair to take the first rudely constructed attempt to reduce a new idea to practice, with its numerical results, or even the slightly more favourable effects I have afterwards supposed, as a true test of the value of the principle, and to contrast therewith the *theoretical results* attributed to a machine of a different construction. Having frequently seen machines upon the exact principle described by "F. F.," I am perfectly justified in affirming that the result they give is very different indeed from that theoretically inferred by him. Indeed, the power of a machine of ten times the size he supposes, is so trifling, that a touch of the finger is sufficient to stop its motion. The success of the method in question, of applying the electro-motive power appears to depend, as "F. F." justly observes, upon the rapidity of motion that can be attained, by means of which an amount of momentum is imparted to the wheels, which makes up, in some degree, for the feebleness of the power acting upon it. Owing most probably to the circumstance which "F. F." alludes to, namely, the retention for a short time by the copper wire, or the iron, or by both, of the current of galvanism after the connection is broken or reversed, a confusion or neutralization of action seems to take place, which may, to some extent, account for the small amount of power rendered available;—an obstacle which of course increases in proportion to the speed of the machinery. This very serious objection does not apply to my machine, in consequence of its comparatively slow motion, and of there being no reversal of the current required.

I was not ignorant, as "F. F." presumes, of the fact that the power of a battery to transmit a current, is regulated by the thickness of the wire; and in the form in which my paper was originally read, this circumstance was distinctly alluded to, though afterwards, for the sake of simplifying the subject, it was left out of view. The remedy in this instance is clearly pointed out by again referring to nature, as shown in the mechanism of the nervous system. The nerves consist of bundles of fibres, each of which is believed to be continuous and distinct from the origin to the termination of the nervous cord, and each probably having its distinct office, which it cannot share with another (see "Carpenter's Manual of Physiology," p. 219.) Now, when the size of the machine is such that one battery cannot sufficiently stimulate the whole of the magnets—cannot, in short, transmit its current unimpaired through the whole extent of wire, without the necessity of an inconvenient thickness of the latter—several more batteries can be added, each supplying, according to its power, a certain portion of the machine, and the whole being made to act in concert,—a result which could be easily obtained. The same objection and the same remedy will apply to any other kind of electro-motive machine whatever.

Another advantage attending a moderately slow action, is, that the galvanic influence having time to accumulate in the battery, is discharged with much greater power and effect, than in the excessively rapid action required in "F. F.'s" mode of working.

Though I cannot pretend to be a practical mechanician, I should presume to doubt the correctness of "F. F.'s" assertion, that the applicability of the rectilinear motion (that of the common steam engine) "to machinery, is *incomparably* more difficult than that of the continuous rotary movement."

I have a strong impression that the

principle developed in my paper could be carried out to far better purpose than in my model, if any ingenious mechanic, who could do justice to the mechanical part, were to direct his mind to the subject. The magnets might be made considerably smaller than in the apparatus described, and connected together—perhaps, by brass articulations—and not allowed to separate more than a twentieth or thirtieth of an inch from one another.

The method in question has, I think, the advantage of more completely accumulating and directly applying part of the enormous force developed by electro-magnetism, and of being more strictly in analogy with the muscular structure and other natural arrangements than the other electro-motive engines that have been described.

It would be much more satisfactory to compare the actual results of working models of different constructions, than merely to dispute about their presumed capabilities. Although I believe that the cost and complication of such a machine as that described by me, would not be greater than those of some machines in actual use, yet such considerations will be sufficient in the meantime, to preclude its use as an economical motive power. When, however, the subject becomes better understood, I do not doubt that the power in question will be practically applied with success.

Coinciding with "F. F." in his wish that further attention may be directed to the subject, till a really efficient and economical arrangement be the result,

I am, Sir, yours, &c.,

WM. FRASER.

Aberdeen, Oct. 23, 1848.

RECOGNITION OF INTELLECTUAL PROPERTY IN GERMANY. BY M. JOBARD.

[*Translated for the Mechanics' Magazine.*]

The National Assembly of Frankfort, in its sitting on the 23rd of September, received the following proposition from the Committee of Political Economy, and adopted it by 174 votes against 159, as the 23rd article of the constitution.

"Every German enjoys the protection of the state for his property, whether material or intellectual.

"Intellectual property, that is to say, literary, artistic, scientific, and industrial property, is placed under the exclusive protection of imperial legislation."

"Property is inviolable."

"No property can be expropriated except on the plea of public utility, and in consideration of indemnity."

Here then we see the Belgium Commission on Patents, which decided that there was *no* right of property in an invention, opposed to the concentrated wisdom of all Germany. We scarcely know how the Commission will refute that splendid work of M. Thiers, on the Rights of Property, wherein he demonstrates that man is a proprietary animal, the same as beavers and bees are constructing animals, and that from the exercise of his faculties is born a second property, which society should consecrate in the interest of all.

It is now manifest that Europe is prepared to receive, as a great fact, that which was first enunciated in Belgium twenty years ago,—namely, that intellectual property should rank side by side with material property, in order even to the preservation of landed property, the rights of which are so vigorously attacked at the present moment.

It is painful to think that mean personal jealousies should cause Belgium to lose the honourable initiative in this matter, which she might have taken at any time during the last ten years. But it is the disastrous consequences which we should regret the most; for it is evident that new manufactures will arise in Germany (which protects them), as soon as Europe is tranquilised, and the manufacturers of Belgium find it to their advantage to transplant their factories to the more favoured territory of the German empire, instead of struggling in the agony of intestine competition, which does not allow them to defend their right of property in the machines and modes of manufacture of their own invention, against infringers; inasmuch as fraudulent imitation appears to be elevated in Belgium into the rank of a national institution.

The *laissez faire tout a tous* having become with us the criterion of free labour, we shall see soon the evil which destroys our linen trade, affect as injuriously most of the other branches of our industry. Marshall, the great linen-manufacturer, wished, at the commencement of his career, to establish his factories in the midst of the flax-producing country, *par excellence*, (Flanders), but the refusal of a patent drove him elsewhere, and thus it is that Flanders, which, if a patent had been granted to Marshall for his machines, would have been the richest country in the world, is now one of the poorest. It is well known that this branch of manufacture used to furnish France with linen-yarns to the value of from 30 to 35 million francs yearly. The money

which now flows into England would have flowed into Belgium, and all that there is of labour and intelligence in Flanders, would have been, and now be, engaged in this unparalleled manufacture. What was Marshall's answer to the ignorant functionary who repulsed him on the childish pretext that he would destroy hand-spinning? "Ah! so, rather than give your spinners better employment at home, you would deprive them of employment altogether by driving me abroad." And thus it was, he established himself at Leeds, placed two agents at Lisle to buy up all the flax of the two Flanders, and send it to England to be spun, whence it returned to compete in our own markets with the produce of our spinners. This is what a country gains by repulsing inventors and inventions! This is how the life or death of whole populations is dependent on the dicta of fools.

Let us continue to repulse what is brought to us; let us drive out foreigners and foreign invention, and Belgium will soon be lowered to the manufacturing level of Paraguay.

GUTTA PERCHA ELECTRIC INSULATORS.

Sir,—My letter of the 14th ultimo, containing some observations upon a new method of insulation introduced by Mr. G. N. Hammerton, has called forth some *very strange* remarks from "G. M." He says that whether the gutta percha collect the water in drops or allow it to diffuse itself equally over the surface of the insulation, is a matter of no *consequence*, since "certain it is, that whatever become of the drops *they do not* PENETRATE *the gutta percha*." Of course not; my meaning was totally different from this. "G.M." fancies I meant that the gutta percha would become *thoroughly* saturated, so as to form a connection *through* the proposed insulator. This is shooting wide of the mark, indeed. The whole tenor of my remarks shows that no such inference can be fairly drawn from my words. It is there stated, that a brisk shower of rain would wet the outside *surface* of the insulator "sufficiently so to become a conductor," thus forming a connection with the wire by reason of the non-collective property of gutta percha, and causing the double movement, as it is technically termed in the Telegraphic Instrument. But independent of this, why substitute a more expensive and less durable material for one which already answers the purpose better, I think, than gutta percha would? Until such time as "G. M.," or some other gentleman takes the trouble to inform me *why* this "gutta percha" is so superior, both as to material and form, for the purpose so frequently mentioned, I must retain my previous opinions. Not a single name has, as yet, been adduced to support Mr. Hammerton's new method, which is, to say the least, singular.

Gutta percha, as applied to covering wires, either individually or otherwise is, undoubtedly an admirable material, and there is but little reason to doubt that it will be extensively used for that purpose.

I am, Sir, yours, &c., THOMAS ARCHER.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Oct. 19	1627	C. Rowley	Birmingham	Handle for umbrellas, parasols, and walking-sticks.
,,	1628	Benjamin Verity and J. C. Haddan	King-street, Covent-garden ... Lincoln's Inn-fields, London	Gas burner.
19	1629	Henry Pershouse	Birmingham	Inkstand.
20	1630	W. B. Moffatt	Spring-gardens	Diaphragm double sewer for separating or combining house drainage and surface drainage.
,,	1631	Joseph Rogers & Sons,	Sheffield	Spring-tang table knife.
,,	1632	Stephen Green	Princes-street, Lambeth	Parts of a water-closet.
21	1633	William Kirkwood	West Thistle-street-lane, Edinburgh	Piston-cock.
,,	1634	William Southam	The Mills, Nuneaton	Self-acting air conductor and ventilator for mill-stones.
23	1635	Ellis Rowland	Belfast	High-pressure steam gauge and self-acting blast regulator.
,,	1636	John Roberts	Eastcheap, London	Horticultural double tile.
24	1637	John Thomas Tucker	Exeter	Universal broach-protector.
,,	1638	James Dubois	Paulton-terrace, King's-road, Chelsea	Annulus scapus, or elastic ferule or wrapper for taps.
,,	1639	Bourjeaurd	Davies-street, Grosvenor-square,	Elastic suspensor.
,,	1640	J. A. Barnett	Salford	Treble symbolic indicator.
25	1641	Charles Parker	Birmingham	Whip-holder.

WEEKLY LIST OF NEW ENGLISH PATENTS.

William Brown, of Cambridge Heath, Middlesex, weaver, for improvements in manufacturing elastic stockings and other elastic bandages and fabrics. October 26; six months.

Soren Hjorth, of Jewry-street, Aldgate, for certain improvements in the use of electro-magnetism, and its application as a motive power, and also other improvements in its application generally to engines, ships, and railways. October 26; six months.

James Clark, of Glastonbury, Somerset, manufacturer, for improvements in the manufacture of boots, shoes and clogs. October 26; six months.

William Longmaid, of Beaumont-square, Middlesex, gent., for improvements in treating the oxides of iron, and in obtaining products therefrom. October 26; six months.

William Church, civil engineer, and Thomas Lewis, woollen draper, both of Birmingham, for a certain improvement, or certain improvements in machinery, to be employed in making playing and other cards, and also other articles made wholly or in part of paper or pasteboard, part or parts of which said machinery may be applied to other purposes where pressure is required. October 26; six months.

Peter Fairbairn, of Leeds, York, machine maker, for improvements in machinery for heckling, carding, drawing, roving, and spinning flax, hemp, tow, silk, and other fibrous substances. October 26; six months.

James Burrows, of Haigh, near Wigan, Lancaster, engineer and draughtsman, and George Holcroft, of Manchester, consulting engineer, for certain improvements in, and applicable to steam engines in the machinery, or apparatus belonging thereto, in the construction and arrangement of boilers for the generation of steam, and in the furnaces and flues used in connection therewith, parts of which improvements are also applicable to other similar purposes. October 26; six months.

NOTICES TO CORRESPONDENTS.

A stamped edition of the Mechanics' Magazine to go by post, price 4d., is published every Friday, at 4 o'clock, p.m., precisely, and contains the New Patents sealed, and Articles of Utility registered during each week, up to the time of going to press. Subscriptions to be paid in advance. Per annum 17s. 4d., half-yearly 8s. 8d., quarterly 4s. 4d. Post-office Orders to be made payable at the Strand office, to Joseph Clinton Robertson, of 166, Fleet-street.

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Edited by J. C. Robertson, 166, Fleet-street.

DAVIES'S PATENT ROTARY ENGINE.

Fig. 3.

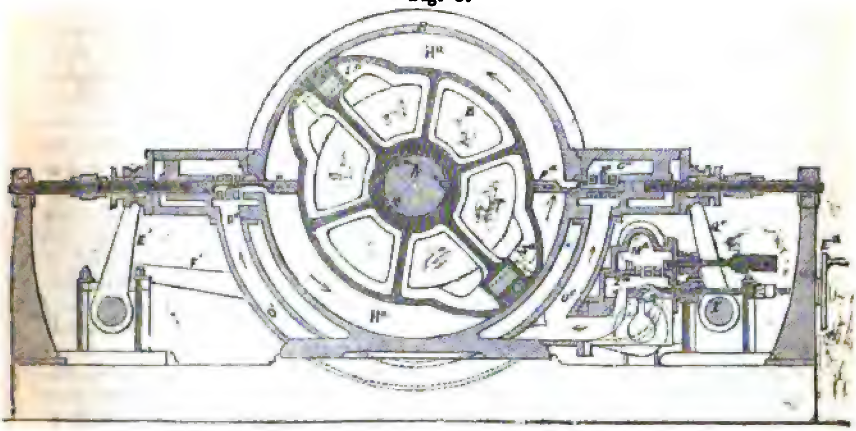


Fig. 4.

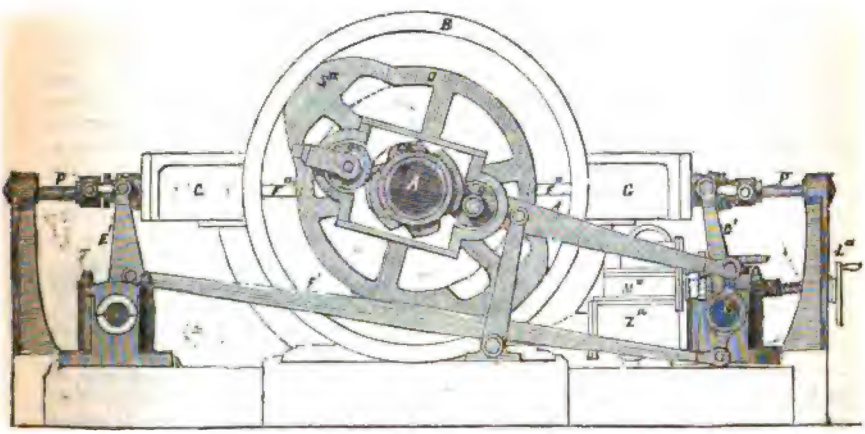


Fig. 6.

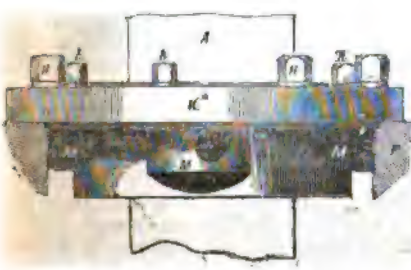


Fig. 8.

DAVIES'S PATENT ROTARY ENGINE, STEAM-PROOF METALLIC PACKING, ETC.

[Patent dated May 2, 1848. Patentee, Mr. Isaiah Davies, engineer, Birmingham. Specification enrolled November 2, 1848.]

Mr. Davies patented some four years ago (April 27, 1844) a rotary engine, of which the present is a greatly improved edition. As it was, Mr. Davies's engine was one of the most promising of its class, and has, to our knowledge, staggered by its performances, the incredulity of more than one obstinate champion of the reciprocating school; and as it is now, it bids fairer, in our humble judgment, than any other in the field, to dispel the existing prejudices on the subject. In all those points which are most essential to the good working of a rotary engine—the perfect steam packing of the shaft, the preservation of the parallelism of the shaft, the equable motion of the piston, and the harmonious action of the steam inlet and outlet valves—the arrangements made in this engine are of so complete a character, as to incline us irresistibly to the conclusion, that if this be not the thing so long sought after—a rotary engine as good as any reciprocating one—there must, in truth, be some radical error in the theory of rotary engines, which no practical skill or ingenuity can overcome. We propose to give Mr. Davies's specification entire, with the suppression only of the merely formal parts, in this and succeeding Numbers, and in the meanwhile we beg to refer our readers to the full statement of his "claims," given in a subsequent part of this number, in pursuance of a new arrangement which we have made for giving every week the claims (at least) of every specification enrolled during the week.

Fig. 1 is a front elevation of a pair of rotary engines on this improved plan, mounted on one shaft; some of the front parts of the left-hand engine being left out in order to expose to view the parts beneath. Fig. 2 is a top plan of the right-hand engine, and a sectional plan of the left-hand engine on the line *a b*. Fig. 3 is a section of one of the engines on the line *e, d, f, g, c, h*, fig. 2. Fig. 4 is a section on the line, *i k*, of figs. 1 and 2 (with the covers of the cylinder, B, and the cam-box removed, in order to show some parts which are not exhibited with sufficient clearness in the other figures). And fig. 5 is an end elevation of one of the engines.

"A is the main shaft which passes continuously through the centres of the cylinders, BB, of both engines, and through the centres of the cylindrical pistons, DD, which revolve within the fixed cylinders, BB, as also through the partition-plate, G, by which the two engines are separated. The end-covers, PP, of the two fixed cylinders are fitted with metallic stuffing-boxes, through which the main shaft, A, passes in the same way as in the rotary engine originally invented by me, and described in the specification of my former letters patent; but the stuffing-boxes which I now propose to employ are on an improved plan of construction, and such as to ensure much more effectually perfect steam-tightness at the parts where the shaft passes through the cylinder covers. The details of my improvements in stuffing-boxes are separately represented in figs. 6, 7 8, 9, 10, and 11, and those I will now first proceed to describe:

"Fig. 6 is an elevation, and fig. 7 a top plan of one of these improved boxes. Fig. 8 is a transverse section of it on the line *r l*, (figs. 7 and 9); fig. 9, a plan on the line *m n*, and fig. 10, a transverse section on the line *p q*. P represents the end cover of one of the fixed cylinders, B B. K is the packing box, the body of which is inserted into an aperture or socket, bored out for it in the cylinder cover; and K^2, a flange, by which and bolts H H, passed through it, the box is secured to the outside of the cover. The under side of the flange, K^2, and the part of the cylinder cover, with which it is brought in contact, are turned true, in order that they may fit one another exactly. The only part of the body of the box which is in actual contact with the sides of the socket in the cylinder cover, is a rim piece, K^1, next to the flange, which is about half an inch in depth, and accurately turned to fit the socket. Beneath this rim piece there are four hubs, M M M M, which project from the body part, but not quite so far as the rim piece, K^1; so that there is free access for the steam to the back of all the body part beneath the rim piece, K. In each of these hubs there is a hole bored through and through for the reception of a spiral spring, N, the

office of which will be afterwards explained. On the inside of the packing-box, it is of two diameters, or in other words, it has two steps or ledges in it, No. 1 and No. 2, concentric to one another. To the top of the bottom step, or ledge (2), there is riveted a flat brass ring, E. The space between that ring and the step 1 is divided circumferentially into two equal parts by two vertical stops, F F,

Fig. 7.

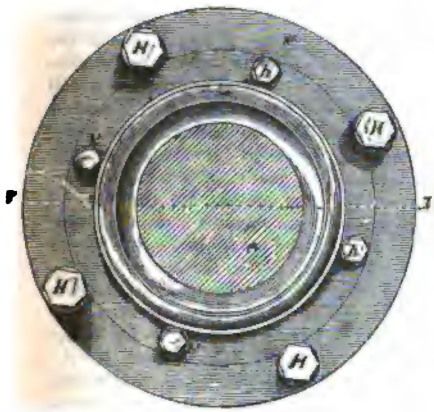


Fig. 9.

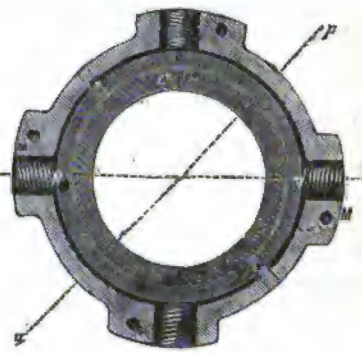


Fig. 10.

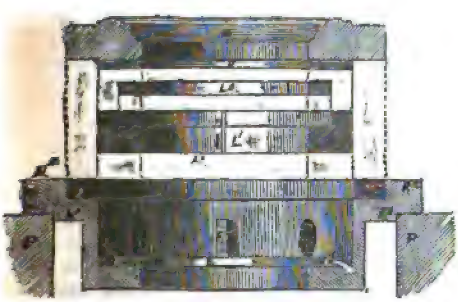
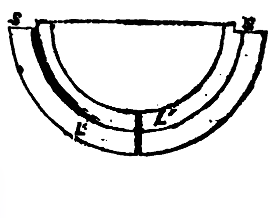


Fig. 11.



which are passed through the body of the box from the back, and extend over the ring E. Two sets of concentric segments, L^1, L^2, are dropped down loosely upon the ring E, one over the other; that is to say, the first set L^1 consists of quarter segments of the sectional form, separately represented in fig. 11, which rest immediately upon the ring E, and abut at one end against one or other of

the stops, F F, which fit into recesses, *s s*, made for them in the segments; and the other set, L^2, consists of smaller quarter segments, which rests in seats cut out for them on the inside of the segments, L^1. All these segments are accurately turned, so as to fit with nicety to, and upon one another, yet with such vertical distances between them as to allow of their being moved to the extent of about one-eighth of an inch both inwards and sidewise, and which concentric segments are moreover so placed in relation to one another, that they shall everywhere break joint (as it is technically termed). T is a circular cap or cover with a brass ring, V, of smaller diameter riveted to the underside of it (similar to the bottom ring, E). The brass ring, V, fits into that part of the packing-box which is of the lesser of its two diameters, immediately above and upon the concentric segments, while the outer rim of the cap rests upon the step or ledge, No. 1, and is made fast to it by the bolts, *h h*. In the sectional view, fig. 10, the packing-box and the parts, $L^1 L^2$, T V, which fit into it successively, are shown detached from one another in order to exhibit more clearly their mutual relations. The spiral springs, N N, before mentioned, press at their inner ends against the concentric segments, L^1, and at their outer ends against the sides of the socket in the cylinder cover; while the stops, F F, serve to prevent the concentric segments from sliding round sideways beyond the stops, F F. The pressure inwards of the springs, N N, serves to keep the concentric segments in constant yet (because of the slight side-play allowed them) nearly frictionless contact with the shaft, A, however much the inner faces of these segments may happen to vary from wear in a long course of work; and should any steam find its way nevertheless; between the sides of the shaft and the inner faces of the concentric segments, as every joint between any two of these segments comes opposite a solid part in the segment immediately behind, and the whole of the segments are covered in at top by the double-seated cap, T, it is next to impossible that any portion of the steam should escape into the back of the packing. And, again, the steam which is left free to circulate round the back of the body part of the packing-box, and to find its way through the orifices in the hubs, is equally prevented by the manner in which the concentric segments are packed together from penetrating beyond them, still serves by its pressure against them ammore effectually to secure the ste ore tightness of the packing, and the m so, the greater the pressure of the steam in the cylinder may be.

"All the parts of this packing-box are made of iron with the exception of the concentric segments, $L_1 L^2$, and the bottom and top rings, E and V, which are made as before stated of brass, because these are the only working parts to which the steam can have access, and the brass is not so liable to corrosion as iron. Sufficient provision is made for the difference in point of expansion between the two metals, by the vertical spaces between the concentric segments. However, there may be cases where the water from which the steam is generated is of so pure a quality that there is nothing to be feared from corrosion, and also cases in which air and not steam supplies the motive force (as in air engines and blowing machines); and in such cases not only may all the parts of the packing-box be of iron, but the bottom ring, E, may be wholly dispensed with; (the depth of the under part of the box, or of the segments, being increased in proportion to the depth of the ring removed.)"

Mr. Davies then proceeds to describe a modification of the packing-box before described. Of this it may be sufficient to observe, that it consists simply in placing the cap or cover, T, at the back, instead of the front of the concentric segments.

(*To be continued.*)

HARBOUR OF REFUGE FOR IRELAND.

Sir, — If the individuals who take an interest in the affairs of this unfortunate country would content themselves with proposing and carrying into effect measures of *ordinary and obvious* utility, it would answer better than chimerical political schemes on the one hand, or measures of mere brute repression on the other.

On the long extent of dangerous coast between Belfast and Dublin—the marine thoroughfare, night and day, of ships of

every nation—there is not a single harbour of refuge. If there be an exception, it is Lough Strangford, but it is only accessible under certain conditions. Ardglass is a mere inlet, fit for fishing-boats; Dundrum is an open and dangerous bay; Carlingford Lough has a bar at the mouth; and from that to Dublin there is absolutely nothing.

I propose to render the entrance to Lough Strangford a harbour of refuge. Here there is no bar of any moment, and there is sufficient depth of water, through the east channel, at all times of the tide, for merchant vessels. Owing to the great expanse of Lough Strangford, however, there is an ebb tide of fearful rapidity, by which such a sea is raised when the wind blows fresh from the opposite direction, as to render the entrance at such times unsafe. Vessels have been wrecked in attempting it. On the other hand, when the wind is moderate, the force of the ebb tide is such as even to carry out vessels against the gale. The depth of water by the east channel is 5½ fathoms. From this to Ballyhenry there is a passage or channel about five English miles long, and from one to two wide, almost equal in beauty to the celebrated Propontis, and of sufficient scope and depth of water to accommodate all the navies in the world. Beyond Ballyhenry the lough forms a wide expanse of many miles in length and breadth. This expanse is dotted with innumerable islands. At low water a multitude of rocks, locally termed *pladdies*, the summits of submerged hills, become visible. This barren and useless waste I propose to reclaim, by forming a dyke from Ballywhite across to Audleystown point, the adjoining rocky hills furnishing an unlimited supply of materials at a minimum cost. A catch water on either or both sides would serve to intercept the inconsiderable runnels which now flow into the lake.

This truly national undertaking could be accomplished at a very moderate cost. The proposed dyke, by neutralizing the current, would render the entrance accessible at all times of the tide. It would, further, reclaim some forty thousand acres of land. The lake, at low water, is for the most part very shallow, and much of the bottom laid bare, and very different from the Lake of Harlaem, now in course of drainage, would involve no engineering difficulties of any moment. A steam engine, of 500 horse-power, placed on the dyke, working, say, Walker's hydraulic engines, would, I apprehend, suffice to drain the residuary waters of this vast expanse.*

We should thus have an admirable harbour of refuge, so much needed along the stormy coast, and proving a real blessing to the tempest-tost mariner. This undertaking would be vastly more profitable than most of our current railways, since the expense would be much more than repaid by the land reclaimed.

I trust that this proposal, on the accomplishment of which I have set my heart, and on which I have pondered for many years, will meet with succourable eyes through the medium of your excellent columns. The prospective advantages to the Irish community, as well as maritime population generally, speak for themselves. Railroads from Newtownards and Downpatrick to Portaferry, would multiply those advantages. I have only to add that the survey of these waters, which now lies beside me, was executed by Mr. Alexander Nimmo, in 1821, for the Commissioners of Irish Fisheries. The lake itself, in the Irish language, was called Lough Cuan, or the lake of the hound, from the surpassing rapidity of its tide. As for the depression which constitutes its bed, it was probably formed in antediluvian times by the upheaving of the adjacent mountains.

I am, Sir, yours, &c.,

HENRY M'CORMAC, M.D.

Belfast, October 22, 1848.

MATHEMATICAL PERIODICALS.

(Continued from page 368.)

XI. *The Student's Companion.*

Origin. This work was commenced at Blackburn, in Lancashire, under the title of "The Student's Companion, a Literary, Mathematical, and Philosophical Miscellany." Two numbers only were published, of which the first appeared in October, 1822, and the second in April, 1823.

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* Even if a steam engine were not employed, some 10,000 acres, I should say, of the lough, would be laid bare. These at 40*l.* an acre, would be worth 400,000*l.* gained to the country by the erection of an inconsiderable dyke. Catchwater drains would not be required, and the residue of the lake would be gradually converted into a beautiful expanse of fresh water.

Editor. Mr. Henry Lightbown, teacher of the Mathematics, &c., Blackburn, Lancashire.

Contents. The contents are Poetry, Miscellaneous Extracts, Enigmas and Answers, Rebuses, Charades, and Answers, Queries and Answers, a selection of Mathematical Questions for Youth, and another selection for more advanced students. In the poetical department are found a "Poem in praise of Mathematical Literature," "The Choice," and a "Poetical List of Prepositions and Conjunctions."

The miscellaneous portion contains "Rules for preserving health in Eating and Drinking;" a piece of advice *not very* necessary for many of the correspondents. The Enigmas, Charades, &c., were principally furnished by Mr. Charles Holt, afterwards Editor of the "Scientific Mirror," and Mr. Henry Clay, afterwards Editor of the "Scientific Receptacle;" but they offer nothing worthy of particular notice. The junior mathematical department was principally supported by the pupils of Messrs. Lightbown, Mitchel, Huntington and Brewer; and most of the senior questions were furnished by these gentlemen or their personal friends. The "Modern Geometry" of the "Student" was reprinted in this periodical to the extent of 32 propositions, as were also the 24 "Lineal Sections" from the same work.

Questions. The total number of senior questions proposed and answered in this periodical is 82, and a set of 16 was left unanswered in the last number. There are some good geometrical and other exercises in the work, among which may be noticed those where "the radii of the inscribed and circumscribed circles are given, to construct the triangles. 1stly. When the sum of the sides is double the base. 2ndly. When the angles are in arithmetical progression." The last question relates to the subject of *envelopes*, and proposes that "if AT, V*t* be two perpendiculars to a given line AV, and on the same side of it, and also that if the rectangle AT, V*t* be constant; to investigate the nature of the curve which T*t* perpetually touches." It was taken from the Cambridge Problems for 1820, and was proposed and solved by Mr. John Huntington, of Preston: a different solution to the same question and its converse may be seen in Wright's Solutions to the Cambridge Problems, vol. ii., pages 61—2. The same property also forms Cor. 3 to Prop. xiii. on the Ellipse, in *Davies's Hutton*, from which an elegant method is deduced of drawing a tangent to the curve. The *general* property of the tangents, the central and contact ordinates, to which this is a corollary, appears to have been first given in page 85 of the "*Mathematician*" of 1751.

Contributors. Messrs. Aspden, Baines, Brierley, Brewer, Clay, Derham, Dewhurst (Vulcan), Fielding, Fowler, Harwood, Holt, Huntington, Jervis, Lightbown (Longwith), Mitchel, Porter, Riley, Ryley, Weatherall, Whitaker, Whiteside, Winward, &c., &c.

Publication. It was issued in half-yearly numbers, and was printed and published by Mr. Thomas Rogerson, *then* of Blackburn, but latterly of the *Mercury* Office, Liverpool.

THOMAS WILKINSON.

Burnley, Lancashire, October 30, 1848.

Errata.

Page 305, col. 1, line 30, for *analysis* read *analyses*.
" " " 2, " 17, from bottom, for *Swell* read *Swale*.
Page 368, col. 2, line 9, for *Rylands* read *Rylande*.
" 378, " 2, " 1, for *Whitby* read *Whitley*.

THE ELEMENTS OF RAILWAY RATING CONCISELY STATED. BY J. W. WOOLLGAR, ESQ., F.R.A.S.

If any of your readers should be surprised at my offering to their notice the apparently *legal* subject of railway parochial rating, I must premise that the legal principles are well known, and that the application of them, wherein the difficulty lies, depends more upon mathematical than any other doctrine.

Hitherto, parish officers have been equally wanting in the necessary data for the purpose, and in the knowledge how to use them. They have generally adopted the easy substitute of assessing railways at arbitrary and often enormously disproportionate rates, leaving the companies to resist the charge if they chose. In this course the parishes have often been successful; but in the present tide of affairs, directors no longer deem rates and taxes as matters beneath their notice.

As among your readers are many persons connected with railways, I shall be obliged by the communication of facts,

showing what are the proportions, in which the outgoings upon a *branch* line are dependant upon the mileage, and upon the gross receipts respectively.

I am, Sir, yours, &c.,
J. W. WOOLLGAR.

Lewes, 30th October, 1848.

1. The gross rental of a railway consists of

1. The gross rental of the stations and other buildings necessary to the occupation of the railway, and which are severally assessable in the parishes where they are.
2. The gross rental of the railway alone, which is to be distributed among the different parishes, according to the earnings in each.

2. A railway ought to be assessed at the same amount collectively, as if the whole of it lay in one parish, whether the earnings be uniform throughout its length, or otherwise.

3. All the quantities hereafter stated are to be considered *annual*.

4. Let the gross receipts of a railway be expressed by . . . . A

5. The deductions (D) admissible on a question of rating are fourfold.

1. The gross rental of stations and buildings . . . G
2. The entire working expenses, ordinary repairs, both to way and stock, servants' wages, government duty, local rates, taxes, and tithe rent charge . . . . . B
3. Per centage on the capital (C) necessary to carry on the traffic, *i. e.*, on the value of rolling plant, furniture, stores, and materials. This per centage covers interest, tenants' profits, depreciation of plant, and contingent liabilities of all kinds . . F
4. Further allowances from the gross rental, sanctioned by Parochial Assessment Act, viz., landlords' renewal repairs, and insurance . . . . H

6. Whence the following—

The gross earnings . . . . $\text{A}-\text{G}=\text{E}$

The total outgoings . . . . . $\text{B}+\text{F}+\text{H}=\text{O}$

The total deductions . . . $\text{G}+\text{B}+\text{F}+\text{H}=\text{D}$

The gross rental which a tenant would give for the whole concern . . . $\text{A}-(\text{B}+\text{F})=\text{R}$

The gross rental which a tenant would give for the railway alone . . $\text{A}-(\text{B}+\text{F}+\text{G})=\text{R}'$

The net rateable value for the railway alone $\text{A}-\text{D}=\text{R}'-\text{H}=\text{V}$

7. Then if M be the miles' length of the railway, the net rateable value of one mile, if the traffic be uniform, or of one mile in a part having average traffic, will be $\frac{\text{V}}{\text{M}}$.

8. In order to deal with a case of unequal traffic, let m be the miles' length of a portion of railway, and let the italics, a, g, e, express, in reference to that portion, the corresponding quantities to A, G, E. A little consideration will show that the outgoings on different portions are not directly proportional either to the traffic, or to the mileage, but have a relation compounded of both those elements. Considering O as divided into two parts, let $1:s$ express the ratio of the whole to the part dependant upon mileage; which may be considered sufficiently constant for the present purpose. Then the first part of the outgoings will be

$$=\frac{ms\text{O}}{\text{M}}$$

and the second part

$$=\frac{(1-s)e\,\text{O}}{\text{E}},$$

9. Whence, by addition and transformation, we have

$$v=e-\frac{\text{O}\,[(1-s)e\text{M}+ms\,\text{E}]}{\text{E}\text{M}},$$

10. If we assume $s=\frac{1}{3}$, the formula becomes more simple,

$$v=e-\frac{\text{O}\,(2\,e\text{M}+m\text{E})}{3\,\text{E}\text{M}}.$$

11. And if p miles of this portion of railway lie in a certain parish, the rateable value in that parish (exclusive of stations) will

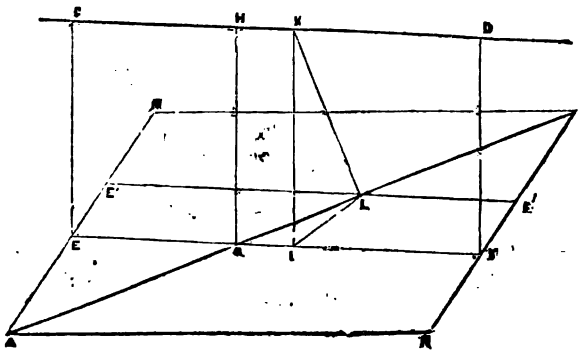
$$=\frac{pv}{m} \quad \text{Q. E. I.}$$

GEOMETRY OF THE LINE AND PLANE.—BY T. S. DAVIES, F.R.S., L. AND E., F.R.S.A., ROYAL MILITARY ACADEMY, WOOLWICH.

(Continued from page 293.)

PROP. XLV.

If two lines, not in the same plane, be given; there can be one line constituted perpendicular to both of them; there can be one such line; and this perpendicular is the shortest line that can be drawn from one of the given lines to the other.



Let AB, CD, be two lines not situated in the same plane; then,

(1.) There can be one line perpendicular to both AB and CD.

Through AB draw a plane MN, parallel to CD; and through CD a plane CF perpendicular to MN, meeting it in EF: let EF meet AB in G; and from G draw in the plane CF the perpendicular to GH, meeting CD in H. Then GH is perpendicular to AB and to CD.

For, since the plane CF is perpendicular to MN, and GH is drawn in CF perpendicular to EF, it is perpendicular to the plane MN; and, therefore, also to the line AB which passes through G in that plane (*prop.* 28.)

Moreover, the line CD being parallel to the plane MN, it is parallel to EF the section of MN by the plane CF (*prop.* 2); and the line GH, being perpendicular to EF, one of the parallels, it is perpendicular to CD, the other.

The line GH is, therefore, perpendicular to both the lines AB, CD.

(2.) There cannot be more than one line drawn perpendicular to the lines AB, CD.

For if there can be a second, let it be KL. Draw KI in the plane CF perpendicular to EF, and join IL; also through CD and L draw the plane CF′ cutting MN in E′F′.

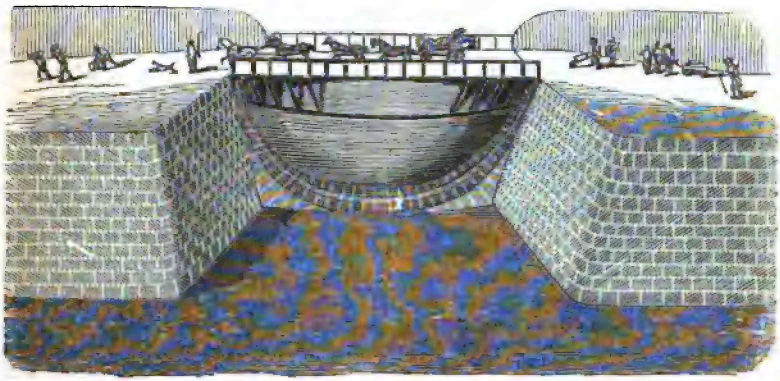
Then, since KI in the plane CF is perpendicular to EF, and the plane CF is perpendicular to the plane MN, the line KI is perpendicular to MN, (*prop.* 28.) Also, E′F′ is parallel to CD (*prop.* 4); and by admission, KL is perpendicular to CD, and hence it is perpendicular to the parallel E′F′. The line KL is, therefore, perpendicular to AB and E′F′ in the plane MN, (*prop.* 24). Consequently from the same point K, two lines KI, KL, can be drawn perpendicular to the same plane MN:—which is impossible (*prop.* 26). Wherefore, the line KL is not perpendicular to AB; and in the same way it may be shown that no other line, besides GH, is.

(3.) The line GH is the shortest that can be drawn from AB to CD.

For, it has been shown in the preceding case that KI is perpendicular to MN, and hence it follows that KIL is a right angle. Whence KIL is greater than KLI; and therefore that KL is greater than KI (*Euc.* i., 18); that is, than GH. Whence GH is the shortest line.

(*To be continued.*)

DESCRIPTION OF THE FLOATING CAISSOON GATE OF THE GREAT BASIN IN PORTSMOUTH DOCKYARD, CONSTRUCTED ON THE PLAN AND UNDER THE SUPERINTENDANCE OF THE LATE BRIG. GEN. SIR SAMUEL BENTHAM.



The caissoon devised by the late Sir Samuel Bentham in the year 1798 for closing the Great Basin in Portsmouth Dockyard was completed and put to use January, 1801. This contrivance was soon afterwards adopted by eminent engineers, but as it is suitable for a greater variety of cases than it has hitherto been applied to, the following short account and description of this caissoon, or floating dam as it was called, may not be without interest.

The caissoon, as well as the inverted arch which Sir Samuel proposed for its reception, were deemed impracticable by the Comptroller and the Surveyor of the Navy, but notwithstanding their objections, his proposal was ordered by the Lords Commissioners of the Admiralty to be carried into execution; it was as follows; and is given at length, since although the dimensions as to depth were calculated for Portsmouth Dockyard, the details indicate points which under other circumstances of depth of water, require to be taken into account.

Sir Samuel Bentham to Evan Nepean, Esq., Secretary to the Admiralty.

"Inspector General's Office,
"September 10, 1798.

"Sir,—I now beg leave to submit for the approbation of the Lords Commissioners of the Admiralty the plan of the entrance of the enlarged basin in Portsmouth Dockyard alluded to in my letter of the 4th of last month.

"According to this plan, instead of a flat bottom of woodwork, and side walls only of masonry, the whole is of masonry in the form of a reversed arch.

"Instead of two pairs of folding gates, one pair for the purpose of keeping the water in the basin, the other for keeping it out, a *floating dam* is made to fit water-tight into a groove wrought in the arch of masonry; by which means the entrance will be shut up, and the water will be kept in or out of the basin.

"This floating dam, which is built much in the form of a navigable vessel, is ballasted so as to float at an immersion of somewhat less than 20 feet, whereby as soon as there is 21 feet water at the entrance, the dam will have risen one foot, which is sufficient to clear it out of the groove, so as to admit of its being hauled away.

"At the height of 20 feet the vessel is covered with a deck, over which, when the dam is in its place, the water is suffered to flow as soon as the tide has risen to its height. By this means the additional flow of the tide, amounting to about two feet at neap tides, and six feet at spring tides, adds very little to the buoyancy of the vessel, and therefore requires but very little additional weight to prevent its rising out of the groove. From the height of 20 feet, as far upwards as

high-water mark spring tides, the water is prevented from passing in or out of the basin by a straight perpendicular bulk-head, erected along the middle of the deck of the vessel, and terminating at each end in what may be called the stem and stern-post of the vessel—these parts being a continuation of the keel; which, together with the stem and stern-post, are all pressed water-tight against one side of the groove formed in the masonry. The bulkhead, or upright part of the dam, is strengthened aloft by a kind of upper deck, which serves as the bridge of communication between the opposite piers.

"According to this plan, therefore, the dam across the entrance would, so far as the height of 20 feet from the bottom, be formed by one of the sides of the vessel: while the upper part of the dam for 20 feet upwards, which has to resist the pressure of the water only a few feet below the surface, is formed by the straight bulkhead. The curvature given to the sides, at the same time that it affords a degree of capacity to the vessel sufficient to make it support the weight of the superincumbent bridge, together with a sufficient quantity of ballast to give it stability, enables the sides likewise, the better to resist the pressure of the water at the greater depth. What little addition of weight it will require to keep the vessel from rising out of the groove at the time of high water, is to be obtained by letting water into one or more of the cisterns formed in the vessel immediately under the deck. This water would of itself run out of the cistern at the time of low water, even at neap tides, by means of the penstocks or valves, as shown in the profile; but if after the water has been let in to fill the cisterns, for the purpose of preventing the dam from floating at the top of high water, it should be required to open the gate on the sudden, the water in the case must be pumped out of the cisterns; this however would be done in much less time, and with fewer men, than are now necessary to open the basin gates on *every* occasion.* I am, Sir,

"Your very obedient servant,

(Signed) "SAMUEL BENTHAM."

"Evan Nepean, Esq.,
"Secretary to the Admiralty."

Both inverted arch and caisson, fully sanctioned and authorized though they were, continued until completion, to be looked upon by many as the idle phantasies of a visionary projector; so that curiosity, with expectation of complete failure, led a crowd of persons to witness the opening of the basin, as described in the following letter from the master-shipwright of Portsmouth yard:—

"Portsmouth Yard,
"Jan. 12th, 1801.

"The great and eventful day is past. Our success is far surpassing my most sanguine expectations. Very early after breakfast, the yard had a wondrous many spectators: admirals, captains, magistrates, surgeons, &c., &c., so that I had really at the docking, scarcely room to move; but I think there were very many disappointed ones. You have no conception of the ease and facility with which we performed, not only the caissoon, but the docking, and undocking. The caissoon is now at 21 feet draught of water. I caused 80 men to get on her bridge, all against the brail. It heeled her nearly 7 inches. I shall, therefore, before floating her again, lighten her 18 or 20 inches: she is now over stiff. What is still more satisfactory, the spoon or scraper for cleansing the groove will refuse nothing that may be at its bottom. I, from accident, kicked a large kind of stone, which, luckily as it happened, went directly into the groove, and sank; which stone, with one or two others, was brought up with other things in the spoon. Depend upon it, all is to your utmost wish.

"HENRY PEAKE.

"Brig.-Gen. Bentham,
"Inspector General of Naval
"Works, &c., Admiralty."

From that time to the summer of 1845, it was found, on inquiry, that this original caissoon had continued in constant use, had undergone no alteration, had had none but very slight repairs; no difficulty had "ever been found in working it," and "nothing could have answered better." Indeed, so satisfactory was its construction considered, that when, after this 44 years' service, it was thought expedient to replace it with a new one—that new one, with the exception of a small addition of breadth, has been made the same as the original caissoon.

* Here follows an account of the plans and drawings which accompany the letter.

As was stated by Sir Samuel, "the advantages of these floating dams are, that they are cheaper of construction than the gates heretofore in use for closing basins or docks; they occupy less space, are more easily repaired, and one and the same dam is capable of serving, as need may require, at different places at different times—as, for instance, in the North Camber Docks at Portsmouth, where the same dam is made to close these docks at different parts of their length, as required for one, two, or three vessels. These dams serve also as bridges of communication for loaded carriages across the entrances they close, and require much less labour than gates in opening or closing entrances by means of them, since their occasional buoyancy is effected without pumping water or unloading ballast."

For closing the new steam basin in Portsmouth yard, the caissoon is of iron, which, doubtless, will be found a considerable improvement as to material, both as regards first cost and durability.

THE TERM "INFINITE."

Sir,—The object of Mr. Pitter (*ante* p. 400) is, as stated by himself, "to make that to be clear and reasonable which now appears dark and contrary to reason." The principal source of difficulty which he has undertaken to grapple with consists in the unwarrantable, unscientific, and still more unmechanical use of the term INFINITE—itself, perhaps, really the least scientific and appreciable, though, at the same time, the most magnificent and sublime term in the English language. Dr. Johnson defines the term *infinite* to be "unlimited, unbounded, having no boundaries or limits to its nature." It is, therefore, a term utterly beyond the apprehension and capacity of a finite being as man, and completely inapplicable to any fact in human science or attainment. Without attempting to enter into any fact as produced by your correspondent, I would just suggest that the proposition, "matter is infinitely divisible," is in itself a pure assumption, and quite inconsistent with the now almost universally received atomic theory of Dalton, which assigns to the *ultimate atoms* of matter a certain numerical ratio—number being the very antithesis of infinity. Logicians are acquainted with a power they term "*reductio ad absurdum;*" let us apply this test to the original theory of your correspondent. Assume for a moment that a mass of matter, one inch square, is composed of an "infinite number of infinitely small particles;" then $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, $\frac{22}{100}$, &c., of the said dimensions would contain respectively $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, $\frac{22}{100}$, &c., of infinity, or of an infinite number, an idea which, doubtles, few others than your *original* correspondent could appreciate. The proposition alluded to would stand more correctly thus—"matter is indefinitely divisible."

With your permission, I will now very briefly examine the grand original principles which your correspondent so gravely tells us, we should clearly understand in dealing with such questions, viz., "*that an infinite number of quantities, infinitely small, produce only a finite result.*" Now, sir, as it is one of the properties of number, that we can either add to, or subtract from it, it is clear that the expression "infinite number" is fallacious. Number is finite. Locke states, that "*finite, of any magnitude, holds not any proportion to the infinite.*" However, leaving this fallacy, we come to something still more preposterous. What can your correspondent mean when he talks of "quantities infinitely small?" That which is infinitely small, must be smaller than the smallest thing that can exist (otherwise it has its limits, even in point of smallness), which is nothing, and, as an infinity of nothings still produce nothing, I think we have clearly demonstrated the fallacy, nay, even the positive absurdity of the original principles of your correspondent, and have proved, still further, the absolute necessity of guarding against the introduction of extravagant and hyperbolical terms, which tend so materially to impede the progress of real science, and which likewise especially tend to perplex and embarrass the student.

Trusting that the above remarks may not be without their use,

I am, Sir, yours, &c.,

J. ANGELL,
Mathematical Instrument Maker.

29, Charles-street, Hatton Garden,
October 24, 1848.

SANITARY MEASURES, NO. 3.—BUNNETT'S SELF-ACTING EFFLUVIA TRAP.

(Registered under the Act for the Protection of Articles of Utility.)

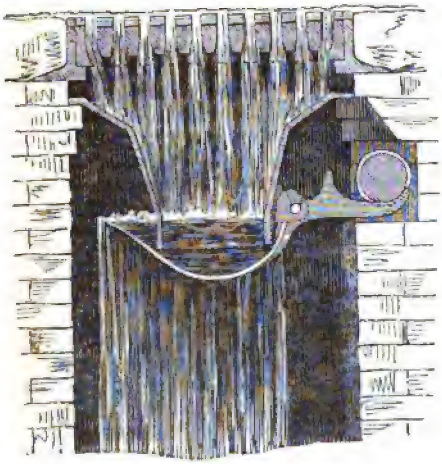


Fig. 1.

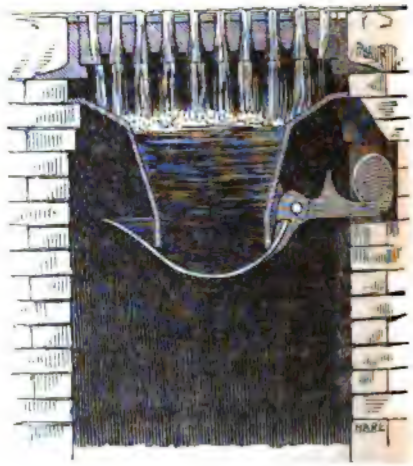


Fig. 2.

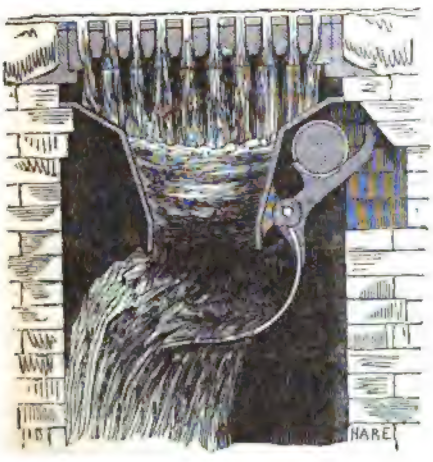


Fig. 3.

Sir,—Since the trapping of sewers was first shown to be desirable, considerable ingenuity has been exercised to devise a form of trap answering the peculiar and manifold requirements of such an apparatus. Invention has followed invention, each one possessing, or being supposed to possess, advantages not found in any of its predecessors. The last contrivance of this kind is the self-acting effluvia trap of Mr. Joseph Bunnett; an invention which combines in a superlative degree the important advantages of simplicity and cheapness of construction with durability and certainty of action. Mr. Bunnett's trap (which is shown in the prefixed engravings) has likewise the advantages of being both *self-acting* and *self-cleansing;* it cannot go wrong or get out of order, and may be applied in all situations without altering the present gratings.

Fig. 1, is a sectional view of a street grating and gully-hole with the trap, which is represented in its ordinary position, the water flowing from the grating into the body of it, and over the edges of the moveable part into the sewer or drain. The lower part of the body of the trap is immersed in the water which is retained in the moveable part by the counterbalance weight, thereby forming a perfectly luted joint, and effectually preventing any smell from rising.

Fig. 2, represents the trap, choked with silt or other matters, the weight of the counterbalance preventing the opening of the moveable part till the body of the trap is two-thirds full of water.

Fig. 3, represents the trap as forced down by the weight of water in the body of it; the force of which effectually cleanses the trap, and flushes the sewer or drain: after which the moveable part

instantly rises to its former position bringing up sufficient water to form the joint again.

There have been previous contrivances in some degree apparently similar, but really differing most essentially in the several qualifications requisite for a perfect self-acting effluvia trap. All the former contrivances for this purpose, that I am acquainted with, have been so arranged that a very small quantity of water caused the pan of the trap to fall, and consequently, during a shower of rain, or run of water, the action was intermittent, continually opening a communication with the drain and so permitting the escape of foul air, and liable to be kept open by any light matter caught by the rising pan. Mr. Bunnett's improvement consists in a peculiar mechanical arrangement of the leverage and form of the moveable pan, as also in the form and application of the weight, which, under ordinary circumstances, admits of a constant flow of water through the grating into the pan of the trap, and over the edges into the sewer or drain; the lower part of the body of the trap being immersed in the water, so as to form an efficient water-luted joint of sufficient depth to withstand the effects of evaporation from long-continued drought.

Should a stoppage be caused by a deposit of silt or other matters, the water will rise in the body of the trap till it is about two-thirds full, when the balance-weight being overpowered, rolls towards the centre, allowing the pan to open to its full extent, thereby insuring a rapid discharge of a large quantity of water, which, by its force, effectually cleanses the trap, and flushes the sewer or drain. The moment the trap is emptied, it returns to its original position, retaining sufficient water to form the joint again; the weight, having rolled back, resumes its former office, until another stoppage brings about a repetition of the cleansing and flushing operation. The form of the trap ensures, at the commencement of a thaw, the instant ejection of any ice that may have been formed therein. This trap is made in all sizes—from that of a street drain to a house sink, all of which are equally efficacious.

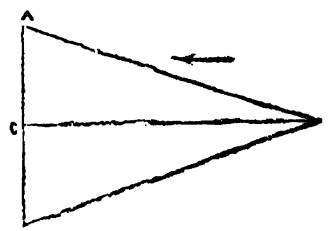
Of all Mr. Bunnett's numerous and ingenious inventions, I know of none that have been so eagerly appreciated, or come so rapidly into extensive employment as his "*self-acting effluvia trap*"—a most gratifying circumstance, not only to the inventor, but also to every person who feels an interest in the progress of sound practical sanitary improvement.

I am, Sir, yours, &c.,
WM. BADDELEY.

29, Alfred-street, Islington,
October 25, 1848.

THE SEA-WALL QUESTION.

Sir,—Touching the point in dispute between several of your correspondents, namely, whether the pressure against the inclining face of a sea wall is as the square of the sine of inclination, and not the cube, allow me to say, that if authority were necessary, there is a case in point in Hutton's Tracts, vol. i., prop. 16, cor. 1, where by a fluxionary process, the pressure against the flat end, AC, of a



bridge pier compared with the pressure against the oblique end, AD, is proved to be as AD^2 to AC^2, that is, by trigonometry, as 1 to $\sin.^2$ inclination ADC.

In the note appended to Sir Howard Douglas's "Protest," it is said, "if the height of the breakwater were *variable*, the pressure would be as the cube of the sine" (which is the fact), but the height of the breakwater, in the case considered, is *not* variable. In the Note, it is added, that by the like resolution of forces, the effects of wind acting obliquely on ships' sails, rudders, flying bridges, &c., are found. All this is correct. I hope no person will doubt that the words "like resolution of forces" means such resolution as is employed to bring out the square or the cube of the sine as the case may require.

The above may be considered as a sufficient reply to the paper signed "Ra-

tio," in the *Mechanics' Magazine*, No. 1316.

In fact, "Ratio" only repeats the arguments of Mr. Smith, and both are *unable* or *unwilling* to see that the law of the cube of the sine is only true on the supposition that the number of filaments which act on the slope is variable.

I am, Sir, &c.,

AN OLD ENGINEER.

REMARKS ON THE PAPER ENTITLED THE "SEA-WALL QUESTION." MECHANICS' MAGAZINE, VOL. XLIX., P. 399.

Sir,—The writer of the Reply to the author of the sea-wall question in the *Mechanics' Magazine*, vol. xlix., p. 234, regrets very much that the columns of this valuable miscellany should be occupied by a subject which takes up considerable space to the exclusion of matter far more important and interesting to the generality of its readers, and he feels very much disposed to "oblige" that gentleman by abstaining from any further notice of his "opinions;" but, since he appears determined, in defiance of demonstration itself, stubborn though it be, to have his own way, and as erroneous statements propounded with an air of great confidence may mislead for a time, the writer hopes he shall be pardoned for once more offering a few words in explanation of the misapprehension under which Mr. Smith is still labouring. Mr. Smith ought not to complain of any annoyance which the following observations may create in his mind, since he has brought that annoyance on himself by going completely out of his way to criticise the formula in the note appended to Art. ii. of Sir Howard Douglas's "Protest" (a formula which, as he admits, has but little to do with "the merits of his sea-wall question,") rashly characterising it as a fundamental error without understanding it, and now persisting in his assertions after their fallacy has been proved. These observations are made, however, in no unfriendly spirit; and the writer would be gratified could he know that they were similarly received. Mr. Smith seems to be puzzled by the introduction of the letter n in the formula for the horizontal pressure; and that he misunderstands its meaning is evident, for though merely a co-efficient, or factor, he calls it a symbol; and it is remarkable that ϕ, which is really a symbol, he designates a "simple factor." His misconception is the more remarkable from the fact that, though he repeats the writer's statement, p. 343 *ante*, that n expresses "the number of filaments which act in the horizontal direction on BC (fig. p. 399), he asks, p. 400, whether it is not then a function of ϕ [$f(\phi)$], and whether the mind can conceive "a change in n without a consequent change taking place in ϕ, or *vice versâ*"! Has Mr. Smith never observed that only the same number of vertical palisades can be planted (in one plane) from the top to the bottom of a hill as on horizontal ground, whose extent is equal to the base of the right-angled triangle of which the slope of the hill, *whatever be its inclination*, is the hypotheneuse? If he has made such observation, let him represent the number of palisades by n, and he will be immediately convinced that n is no function of the inclination of the side of the hill to the horizon, but, in the case supposed, as well as in that of a sea-wall of given height, is entirely independent of the inclination.

In the argument drawn from the equation $n = \text{AB sin. } \phi$, there exists a fallacy which it is surprising that a man with any pretensions to science should have failed to observe. The product AB sin. ϕ, when AB is expressed in feet or inches, is equal to the length of BC in feet or inches; but BC being by hypothesis constant, if the base CA be increased or diminished, the angle ϕ may be varied at pleasure, and AB will then vary with cosecant ϕ, or with $\frac{1}{\text{sin. } \phi}$; therefore, from the above equation, n is a multiple of $\frac{\text{sin. } \phi}{\text{sin. } \phi}$, or is entirely independent of ϕ. It follows that the value of n ought *not* to be expressed "in terms of ϕ;" and the law of impulse (a force varying with the cube of the sine of ϕ), which is founded on the supposition that n is so expressed, is not that which belongs to the circumstances of the case.

The writer has certainly no wish that Mr. Smith should "again enter on this unpleasant subject," p. 400; but he cannot help recommending to that gentleman not to enlist on his side the names of men so known to science as Moseley, Hutton, and Lardner, since, in the strife, they will assuredly be arrayed against

him. On referring to the works of those mathematicians, it will be found that, where the mechanical pressure of a fluid on a plane is made to vary with the cube of the sine of the inclination, the plane is supposed to change its position with respect to the direction of the motion of the plane or of the fluid, as in the well-known problem for determining the position of a ship's rudder in which its power to turn the vessel is a maximum; in such a case, the value of n, or the number of filaments, does indeed vary with the inclination. But if a reference to authority is of any value for the subject under consideration, it may be sufficient to state that a case in point, or one in which n is independent of ϕ, occurs in the writings of mathematicians and engineers who have treated of the pressure exerted by the current of water in a river against a pier of a bridge: for instance, in "Hutton's Tracts" (Tract i., cor. to prop. xvi.), where the course of the stream being parallel to the axis of the pier, and the head of the latter being a double inclined plane, the pressure on the perpendicular face, as BC (fig. on p. 399 *ante*) is shown, by a fluxionary process, to be to the pressure on an inclined face AB, as AB^2 to BC^2; that is, as unity (square of radius) to the square of the sine of the inclination of the face to the current.

It ought to be observed here, with reference to the doubt implied in the remark, p. 400, col. 2, *ante*, whether water at rest or in motion is considered, that, in the application of the theorem, p. 343, to a sea wall, it has been supposed that a body of water in motion horizontally impinges on the wall; and the hypothesis allowed in all investigations of this nature, that the fluid particles escape immediately after impact, is adopted; but, if the fluid were supposed to be at rest, and to act hydrostatically against the wall, the formula for the pressure would be the same as that which is given on p. 343; only q, instead of being constant, would have varied with the depth of each particle below the surface of the water.

DIFFUSION OF SOUND.

Sir,—It may not be known to every one that the two experiments cited in the report of Professor Faraday's lecture at the Royal Institution, and also alluded to by Mr. Hyde Clarke in your Magazine, No. 1308, in his observations on the construction of musical instruments, are by no means new, as the effect of such arrangements have been long known, and the principles adopted by the natives of Africa in the construction of their musical instruments. About eighteen years since a relative of mine brought from the coast of Africa a specimen obtained from the natives. The generator consisted simply of a piece of ebony about 5 inches square and 1 inch thick, across the centre of which was fastened another piece of the same material, about an inch in depth, and half an inch wide, into which was fastened parallel with the base-board six or eight pieces of iron of different lengths —somewhat resembling the generator in a musical snuff-box. The diffuser, which could be fastened (at any convenient distance) to the piece of ebony, consisted of the thin hollow shell of a vegetable resembling a large pumpkin or gourd, which, if I remember rightly, was called a calabash. When the little pieces of iron were struck with the thumb nails, a remarkably loud humming sound was produced, but take off the calabash and the sounds were scarcely audible.

G. T. P.

North Walsham, October 25, 1848.

BLAST FURNACES.—REMARKABLE ACCIDENT.

Sir,—At one of our blast furnaces, blown with heated air, while the blast was shut off for a few minutes, as is usual after casting, an explosion took place inside the pipes, which, from its effects, we consider extraordinary. In the pipes immediately outside one of the stoves for heating the blast, and at the end next the furnace, is a stop-valve—a circular disc of cast-iron, $1\frac{1}{2}$ inches thick and 12 inches diameter, cutting off the connection between a line of cold blast pipes and the hot air pipes. This valve, by the force of the explosion, was literally *shattered*. Several of the joints in the line of cold blast pipes, with which the breaking of this valve opened a connection, were blown out, and another stop-valve in the large main, at a distance of 20 yards, was also broken in pieces: there the explosive mixture escaped in flame at the waste. The furnace

at the same time belched out a great quantity of the materials in front.

Will any of your scientific correspondents have the kindness to explain the nature of the explosive compound likely to be formed in the hot air pipes?

It appears to have been generated in the furnace, and *fired* by the pipes of the stove being red hot, which they very soon become (if the fireman is at all careless) when the blast is not passing through them.

I am, Sir, yours, &c.,
AN OLD SUBSCRIBER.

Merthyr Tydvil, Oct. 31, 1848.

PRACTICAL SUGGESTIONS SUBSIDIARY TO A GENERAL SURVEY OF THE KINGDOM.

Sir, — In the month of last May I perceived by the proceedings in Parliament that an Act was being passed by the Government for various sanitary measures which involved the necessity of new surveys and levellings throughout the kingdom, and having for many years had an idea in my mind, of the utility of connecting together and registering the various lands of the kingdom in reference to some given standard, and thinking that the above surveys, &c., afforded an excellent opportunity of getting my object effected, on the 29th of the same month, I addressed a letter to Lord Viscount Morpeth, of which the following is a copy. His lordship kindly favoured me with a reply, to the effect, that my proposition must be left to the decision of the several local bodies in whom the power of executing the above Act would be vested; but as from long and very severe illness I am prevented making application to those parties, and having no private interest in the matter, except the gratification of being the means of introducing the measure, as I conceive, for the public good, I have forwarded the particulars to you for publication.

I am, Sir, yours, &c.,
W. H. JAMES.

Copy of a Letter addressed to Lord Viscount Morpeth by W. H. James, C. E., May 29th, 1848.

My Lord,—As I perceive, by the newspapers, that it is the intention of the Government to institute new surveys and levellings throughout the kingdom, for the purpose of effecting a more perfect system of drainage and other sanitary measures, I have taken the liberty of addressing this letter to your lordship, as a member thereof, and, as I am informed, the original propounder of these measures, to offer a few suggestions, which I think might be carried out simultaneously, without causing much additional outlay, and which if adopted would, in my humble opinion, be found very useful, not only in connection therewith, but also in connection with numerous other public, as well as private undertakings. I propose that, in a conspicuous portion of the walls of every parish church throughout the kingdom, there should be firmly fixed and imbedded a block or frame of cast-iron, presenting an external surface of about 12 to 18 inches square, and situated, say, from 5 to 7 feet above the ground. Then, that the levels of their various centres be ascertained, in reference to low-water mark at any eligible sea-port. This being performed, and the accuracy of these measurements properly verified by cross travellings, that brass, zinc, or other suitable plates should be permanently attached thereto, having engraved upon them the several levels before mentioned, in feet and decimals of a foot, and numbered consecutively, so as to allow of their convenient registration. The object of obtaining these levels would be to form, by their means, so many *standard points* of departure in all future levellings, whether for the construction of new railroads, canals, docks, gas and water mains, sewers, or for the drainage of land, mines, &c., &c., so that *one chain of connection* throughout the whole might be preserved and registered for *future reference*. The great utility of these registrations, may be instanced particularly in respect to mining affairs, as affording data for any renewed operations, after, perhaps, a suspension of works for many years; indeed, the same observations will also apply to underground works generally, and in a minor degree to all other works. Another advantage may also be named, viz., that of enabling the differences of level between any, even the most distant parts of the kingdom, to be ascertained by the simple subtraction of one level from another, or still more readily, by the mere inspection of a sliding-scale properly adapted thereto; in addition to which, as by means of these standard levels others might be obtained at any District Observatories, they would greatly tend (if so employed), to facilitate the making of barometric, electric, magnetic, and other scientific observations, for more perfectly elucidating various phenomena of the atmosphere, &c. &c., and more especially if their geographical positions were also taken and registered.

It may perhaps be proper for me to add,

in conclusion, that my only object in recommending these engraved plates to be attached to the walls of churches instead of other localities, is (as far as possible), to prevent their defacement and removal by mischievously-disposed persons; and as I am aware this proposition may be liable to disapproval, under the impression that it will be necessary for surveyors and other persons employed, to have the liberty of entering churchyards, possibly at improper times, for the purpose of connecting the several measurements before referred to, with these standard level points. I beg to add, also, that such intrusions can be entirely obviated, by causing horizontal lines to be engraved across the centres of the several plates, and coloured in a similar manner to the vane of a common levelling-staff, so as to enable such persons, by means either of the spirit-level or theodolite, so to connect these various levels, not only with the greatest accuracy, but at such distances, as to render their operations perfectly unobjectionable.

I beg to subscribe myself,

Your Lordship's very obedient Servant,

W. H. James, C. E.

To Lord Viscount Morpeth,
12, Grosvenor-place.

REFORM AT CAMBRIDGE.

(From the *Morning Chronicle* of November 1.)

It is with no common pleasure that we refer to the subjoined announcement of yesterday's proceedings in the Senate of Cambridge. The University has, by a single effort, taken the ground from under the feet of its adversaries. They accused it of insensibility to the progress of events, insensibility to the advance of knowledge, and, above all, insensibility to its plainest duties. Each of these reproaches will in future be an impossibility. It has given way, indeed, and has, perhaps, yielded something of its convictions; but it has conceded nothing to external compulsion. At no period was it easier for it to manifest with impunity an unenlightened and impracticable conservatism. An attack has just been made on it, in the form of a requisition addressed to the prime minister for its reform, and the minister was known to have declared himself unequal to a struggle with the academical bodies. The University, however, wisely selected, for the modification of its polity, a moment when no change could be effected that did not flow immediately from its free will. Its tactic, if the mere discharge of its duty can be called so, has been unexceptionable; its exterior defences may at some future time be weaker than at present, but its moral claim to be exempt from foreign control will, in consequence of the movement it has made, be infinitely stronger. And not only has it shown that it understands the times, but that it appreciates the onward march of knowledge, and will, when the proper period arrives, be ready to engraft on its educational system every science that is full-grown or reasonably developed. It is impossible for any candid person to read the catalogue of subjects henceforth to be studied at Cambridge, and assert that any one of the sciences mentioned has been recognized a single year too late. Some of them, indeed, are hardly yet sufficiently advanced to constitute the intellectual food of unformed minds. Above all, the University yesterday declared that, in spite of all obstacles never fairly allowed for out of the academical precincts, it will really educate in future all its students alike: that it will in future strictly and sternly discipline them, at the cost of disgusting and repelling the very many who do and will consider college a school of life and manners, far more than of the intellect.

The number of votes proves that the resident members of the University must have mustered all their strength. Our readers will understand that it is generally matter of delicacy with the non-resident voters to leave purely academical questions to the decision of the residents. We presume that this was the case yesterday in great measure, though, of course, it could not have been so altogether. We have heard too little of the energetic "whipping in" incident to the occasions when chancellors and members are to be chosen, for us to believe that a very large number of non-resident master of arts was present. We, therefore, regard the Senate's vote as, in the main, the resolution of the resident fellows and tutors —of the very men who have had most to do with the old system. As such, the decision

is calculated to inspire the fullest confidence in the genuine liberality of these gentlemen, and the moral effect of the comparatively large majorities is the greater.

Cambridge, October 31.—A congregation was holden this day, for the purpose of presenting for acceptance by the senate, graces confirmatory of the adoption of the Report of the Syndicate appointed to consider of the best means of affording encouragement to those studies for the pursuit of which professorships have been founded in the University.

Separate graces were offered for adopting the regulations proposed in parts A, B, C, D, and E, respectively.

Section A.

"(A) That, at the beginning of each academical year, the Vice-Chancellor shall issue a programme of the subjects, places, and times of the several professors' lectures for the year then to ensue.

"That all students, who, being candidates for the degree of B.A., or for the honorary degree of M.A., are not candidates for honours, shall, in addition to what is now required of them, have attended, before they be admitted to examination for their respective degrees, the lectures delivered during one term, at least, by one or more of the following professors :—Regius Professor of Laws, Professor of Physic, Professor of Moral Philosophy, Professor of Chemistry, Professor of Anatomy, Professor of Modern History, Professor of Botany, Woodwardian Professor of Geology, Jacksonian Professor of Natural and Experimental Philosophy, Downing Professor of the Laws of England, Downing Professor of Medicine, Professor of Mineralogy, Professor of Political Economy; and shall have obtained a certificate of having passed an examination satisfactorily to one of the professors whose lectures they have chosen to attend.

"That all students, who, being candidates for the degree of B.C.L., do not pass the examinations for the first class in that faculty, shall, in addition to what is now required of them, have attended before they be allowed to keep their act, the lectures delivered during one term, at least, by one or more of the following professors :—Regius Professor of Physic, Professor of Moral Philosophy, Professor of Chemistry, Professor of Anatomy, Professor of Modern History, Professor of Botany, Woodwardian Professor of Geology, Jacksonian Professor of Natural and Experimental Philosophy, Downing Professor of Medicine, Professor of Mineralogy, Professor of Political Economy, and shall have obtained a certificate of having passed an examination satisfactory to one of the professors whose lectures they have chosen to attend.

"That this regulation shall apply to all students answering the above descriptions who shall commence their academical residence in or after the Michaelmas term of the year 1849."

Section B proposes the establishment of a new honour tripos, to be called the "Moral Sciences Tripos."

Section C, that a "Natural Sciences Tripos" shall be established.

Section D, that there shall be a Board of Mathematical Studies.

Section E, that all persons who present themselves for examination at the theological examination, established by grace of the Senate, May 11, 1842, be required to produce a certificate of having attended the lectures delivered during one term, at least, by two of the three theological professors, viz., the Regius Professor of Divinity, the Margaret Professor of Divinity, and the Norrisian Professor of Divinity.

The votes on each section were as under,

	Black Hood, or Non-Regent House.		White Hood, or Regent House.	
	Placets.	Non-Placets.	Placets.	Non-Placets.
Section A..	101	41	67	34
" B..	94	44	61	39
" C..	89	47	60	40
" D..	97	38	71	28
" E..	84	41	57	35

The report was consequently adopted intact.

The *Times* states that "the nation owes a debt of gratitude to the Prince Consort, the Chancellor of the University, for having been the first to suggest, and the most determined to carry out, this alteration in the Cambridge system."

GLASS PIPES.

Sir,—I feel it a duty I owe to you and to my employers to inform you that I have just returned from the seat of the Earl of Zetland (Upleatham Hall), in Yorkshire, having laid down and jointed 900 feet of glass pipes, obtained from the manufactory

of the Bristol and Nailsea Glass Company. The weather was extremely unpropitious—rain, hail, or snow almost every day: still, the work was accomplished to the satisfaction of all parties concerned; and I rejoice to be enabled to send you this brief notice of the longest line of glass pipes yet laid down in the kingdom.

I am, Sir, yours, &c.,

HENRY MALCOLM.

Bristol, October 31, 1848.

[Our correspondent would still further oblige us by favouring us with a description of the manner in which the pipes are *joined together*.—ED. M. M.]

MR. MOY'S MODE OF REGULATING THE SUPPLY OF WATER TO STEAM BOILERS.

Sir,—At page 397 of Number 1315, I see "a mode of regulating the supply of water to steam boilers," communicated by Mr. T. Moy. Permit me to refer your correspondent to page 376 of your 21st vol., where he will find a description of a similar plan, communicated by myself upwards of fourteen years ago. There is a trifling difference in the mechanism, but the principle is identically the same. I have never heard that any one has thought so well of the plan thus gratuitously presented then, as to adopt it in their practice. I thought very highly of the arrangement when it first occurred to me, and fourteen years' reflection has not furnished any inducement to alter that opinion. I feel somewhat flattered by the re-invention of the contrivance by Mr. Moy, and hope his resuscitation thereof may lead some one to appreciate its usefulness. I remain, Sir, yours, &c.,

WM. BADDELEY.

29, Alfred-street, Islington, Oct. 23, 1848.

NEW SCREW STEAMER.

A new iron screw steam vessel, named the *Earl of Auckland*, belonging to the General Screw Steam Shipping Company, has, during the past week, been completed and tried on the river Thames.

She is the first of a new line of vessels intended to run between England and the Mediterranean, and is of the burthen of 450 tons, with auxiliary engines by Messrs. Maudslay, Sons, and Field, of 60 horse-power collectively, on the direct action principle. With this small proportion of power — one horse-power to each 7½ tons—the *Auckland* attained, at the measured mile in Long Reach, a speed of 9¼ knots, or 10¾ statute miles through the water—the slip of the screw being less than 10 per cent.

We doubt whether so good a result as this has hitherto been realized by auxiliary steam power. The Company to which this vessel belongs is under the management of Mr. Laming, to whom great credit is due for the successful manner in which the application of auxiliary steam power has been carried out in the Rotterdam trade.

SPECIFICATIONS OF ENGLISH PATENTS ENROLLED BETWEEN THE 1ST AND 4TH OF NOVEMBER, 1848.

[The specifications of patents are so numerous, and often of such great length, that it has been at no time *possible* for any journal to give *all* the specifications enrolled, or even the most meagre abstracts of them; neither, in point of fact, has any journal ever done so. It has occurred to us, however, that there is one thing within our power to do, without any inconvenient encroachment upon our columns, which might be of considerable service to all interested in patent property, or in the progress of the arts and manufactures, and that is, to publish the "Claims," at least of each patentee as soon as enrolled. Vague as these "Claims" may be, and often are, persons acquainted with the subject-matters to which they relate, may always gather from them sufficient, either to quiet anxiety or to warrant further inquiry. We propose, therefore, in future to give every week the claims of all the specifications, without exception, enrolled during the week, accompanied occasionally with explanatory details or remarks. Of the more important of them we shall continue to give full accounts, as usual, in the leading pages of our Journal. —ED. M. M.]

ISAIAH DAVIES, OF BIRMINGHAM, ENGINEER. *For certain Improvements in Steam-engines and Locomotive Carriages, parts of which are also applicable for other motive purposes.* Patent dated May 2, 1848; specification enrolled November 2, 1848.

Claims.—*First*, I claim the improved double acting rotary engine described, in so far as respects the mode of packing the working shaft, and the adjustable

bearings by which its parallelism is preserved, the use of two abutments or projections in the cylindrical piston, the mode of connecting the piston to the shaft, the peculiar curve given to the cams which regulate the motion of the sliding-stops, the substitution of friction rollers for the fixed curve pieces or tappets, heretofore used in combination with such cams, and the mode of working the expansion valves by a combination of parallel levers with a double-acting cam motion; each as before respectively described.

Second, I claim the adaptation to single acting rotary engines of the kind described in the specification of my former letters patent of the 27th of April, 1844, of such of the improvements enumerated in the preceding claim as are applicable thereto, and as have been hereinbefore pointed out and explained.

Third, I claim generally the improved packing-box before described in the peculiar combination and arrangement of parts of which the same consists, and to whatever shafts or shafting the same may be applied; that is to say, I lay no claim to the use of concentric segments, or to the arranging of these segments so as to break joint, or to the employment of metallic springs, or steam, to act upon those segments in any other than an inward direction; but what I claim as the improvements peculiar to the said improved packing-box are the rim-piece, by which the body of the box fits closely into the aperture in the cylinder cover, the passages left for the steam at the back of the box, the two concentric steps or ledges on the inside, one of which serves as a seat for the concentric segments (and bottom ring, if any,) and the other as a seat for the outer rim of the top cover, the concentric segments in so far as the outer or larger series of them have seats cut out in them for the inner or smaller segments, and in so far also as all these segments have such vertical spaces left between them as to allow of their moving as well inwards as sidewise, and finally the combined use of metallic springs and steam pressure to press the said concentric segments inwards (not outwards as usual).

Fourth, I claim the connecting of the shaft to the piston of rotary engines in the manner before described, to whatever sort of rotary engine the same may be applied.

Fifth, I claim the peculiar combination of parallel levers and a double-acting cam motion, before described, whether the same is applied to work the expansive valves of my own or of any other description of steam-engines, rotary or reciprocating; and its application also for the like or other purposes to other engines and machines.

Sixth, I claim the first of the modes before described of connecting the engine in locomotive carriages with the driving-wheels, in so far as regards the peculiar curve given to the gabs, and whether the said engine is of the rotary or reciprocating kind.

And, *seventh*, I claim the second of the modes, before described, of connecting the engine in locomotive carriages with the wheels, in so far as regards the mode of mounting and fixing the engine and the wheel gearing employed to transmit the power of the same.

(For details of this specification, see *ante* pp. 434-5.)

Isaac Hartes, of Rosedale Abbey, Yorkshire. *For certain improvements in machines or machinery for rowing, sowing, and manuring land.* Patent dated May 2, 1848; specification enrolled November 2, 1848.

The object of the improved machinery described in this specification, is to deposit upon the land manure and seed in successive portions, and not in continuous streams, as has hitherto been the case. A cart is divided vertically into two compartments, one of which contains the manure and the other the seed. A roller, placed crosswise underneath the cart, is made to rotate by the action of the cart wheels, and is studded with a set of projecting blades, made sufficiently long to pass through openings in the bottom of the manure compartment, whence they take the manure, and drop it on the ground in successive portions, smaller or larger, according to the length of the blades. Underneath the seed compartment, there is an endless band, which is carried on two rollers (one of which is also made to rotate by the action of the cart wheels), and to which are attached a number of projecting pieces of metal, which pass at a point immediately over the top roller into the bottom of a spout leading from the seed-box, and there take up portions of seed, which they subsequently deposit regularly upon the ground as the wheels revolve.

The following arrangement may be substituted for the endless band:—The revolving roller is placed nearer to the ground, and furnished with projecting blades. Sets of cups or spouts are employed to convey the seed from the reservoir, underneath the terminations of which pass these projecting blades, which play the same part in distributing the seed as the projecting pieces on the endless band.

To bring the surface of the land, after it has been partially prepared, into regular rows, the patentee employs a plough, attached to the body of the machine with mould boards placed in the necessary posi-

tion, in relation one to the other, for that purpose:

The patentee claims,

Firstly. The improved machine for sowing and manuring land, first hereinbefore described, in the peculiar combination of parts of which the same consists, and of which combination the peculiar features are, the mode of acting on the manure depositing blades and the seed depositing blades, so as to cause them to deposit the same in successive portions, instead of in continuous streams.

Secondly. The modification of this machine, in so far as regards the placing of the revolving roller nearer to the ground, and dispensing with the endless belt; and

Thirdly. The attaching to these machines mould boards, placed in the relative positions described.

WILLIAM JOHN NORMANVILLE, of Park Village, Middlesex, gentleman. *For certain improvements in railway or other carriages, partly consisting of new modes of constructing the axle-boxes and journals of wheels; also an improved method of lubricating the said journals or other portions of machinery, by the introduction of aqueous, alkaline, oleaginous, or saponaceous solutions.* Patent dated May 2, 1848; specification enrolled November 2, 1848.

This invention has reference to making the axle-boxes of railway or other carriages air-tight (with the exception of a small air-hole in the lid), in order to prevent the admission of extraneous substances between the rubbing surfaces of the journals and brasses; and for the more effectual lubrication of such surfaces by the introduction of more suitable lubricators (for which an air-tight vessel is necessary). It consists in attaching to the outer edge of the axle-box a shield or collar of vulcanized caoutchouc or any other suitable elastic material, through which the journal passes. The diameter of the hole in the centre of the collar is smaller than that of the journal, so that it may collapse tightly round the latter, and form an air-tight joint. The elastic shield is protected from exterior injury by another of metal, bolted to the axle-box, and which, being more or less tightened, presses upon the outer periphery of the elastic shield, and occasions more or less pressure, as required to maintain the joint upon the axle. A modification of this arrangement consists in the introduction of a metal ring, kept by the contractile force of the elastic shield in contact with the axle. This ring is in four parts, with the joints so arranged as to intercept (?) the passage of the grease, and yet allow the parts to close, as its interior surfaces wear. Another modification consists in the introduction of a flexible leathern ring round the axle, using the contractile force of the elastic shield to maintain a close pressure upon it. These axle-boxes are filled mith a saponaceous grease in a semi-fluid state. The employment of free oils is to to avoided on account of their liability to absorption by the India-rubber, &c. A last modification consists in substituting the expansive for the contractile force of the caoutchouc. The collar, in this case, is a fixture on the axle, and of a larger size than the space it is intended to occupy, so that it may press tightly on one side against the nave of the wheel, and on the other against a brass washer, which is thereby pressed tightly against a polished plate screwed to the axle-box, and forming the end of it. The brass washer, which is made to revolve with the collar and axle, rubs upon the polished surface of the plate, forming the end of the axle-box, and effectually closes it. It is stated, that from the ease with which these axle-boxes can be applied, and their durability, a great saving will be effected in the "lifting" of railway carriages to remove worn-out "brasses."

The patentee claims—

Firstly. "My peculiar combination of various elastic and other materials, as hereinbefore described, with the axle-box and journal, for the purpose of rendering the lubrication of the journals of railway wheels and other moving parts of machinery, more perfect."

Secondly. "The arrangement, described, for enclosing the lubricator within a vessel which shall retain it and exclude the dirt."

RECENT AMERICAN PATENTS.

(Selected from the *Franklin Journal* for June.)

IMPROVEMENTS IN STEAM BOILERS. *Abram S. Valentine.*

The patentee says,—"The nature of my invention consists in forming two square or other shaped reservoirs, which are connected together by tubes standing vertical, their ends opening into said reservoirs. The front tubes of the boiler thus constructed, are made to form the back of the fire chamber. From the lower reservoir, a fire grate extends upwards at an angle of about 70°; the smoke, &c., passes through between the pipes and up the chimney at the back of the boiler."

Claim.—"The construction of the generator, consisting of the separate steam chamber or upper reservoir, and lower separate reservoir, so as to allow them to move apart, as the tubes which unite them expand in the manner above described, in combination with the fire chamber, formed between the tubes of the boiler and grate, constructed

and arranged in the manner and for the purpose set forth."

IMPROVEMENTS IN CUTTING THE THREADS ON WOOD SCREWS. *Cullen Whipple.*

This machine is intended simply to cut the threads or worms upon the blanks, which are to be formed into wood screws, after the heading and cutting of the nicks or slits in the heads have been completed.

Claim.—" I claim the manner in which I have combined the shaft with the circular wedge on the shaft, so as to cause said circular wedge to raise the shaft by its action on the projecting piece and the tube, said tube being connected with the box, and the whole being arranged, and operating substantially as set forth.

" I claim the manner in which I have constructed, arranged, and combined the conical cam, furnished with the recesses, with the lever, the shaft, and the cutting-arm, so as by their combined action, and that of their immediate appendages, the cutter may be forced against, and removed from the blank to be cut, at the proper intervals, and in the manner described. I claim the regulating the feed of the cutter in its successive operations on the blank, by the raising of the conical cam, so as to cause a part of larger diameter to act upon the lever. I claim the so forming of what I have denominated the conical cam, as to give the desired taper to the screw, to be cut by means of the increasing radius of its curvature as set forth. I claim the manner of raising the conical cam by means of the lever, by the action thereon, of the pins on the ratchet wheel as set forth. I claim the manner in which I have combined and arranged the lever, its catch or pall; the cam on the shaft; the rim or flanch of the ratchet wheel; and the clutch by means of its arm, so as to co-operate with each other, and with the lever in governing and regulating the cutting of the screw. I claim the manner of making or forming the cutters or chasers, to be used in combination with a machine for cutting wood screws, said cutters having a groove formed along their cutting sides, so as to cause them to cut simultaneously on both sides of the thread, and finally to cut the edge of the thread itself, said groove being of the proper width and depth for that purpose, by which construction the cutters or chasers may be sharpened by grinding or setting them to a simple bevel at their ends, without interfering with the notch or groove, by which they are made to cut on each side of and to form the thread."

IMPROVEMENTS IN TANNING LEATHER. *William Zollickoffer.*

Claim.—" The application of the muriate of soda, supertartrate of potassa, and tartaric acid, as a bate for bating all description of hides and skins."

IMPROVEMENTS IN LOCOMOTIVE STEAM-ENGINES. *Matthias W. Baldwin.*

Claim.—" I claim principally, the manner in which I connect the four truck wheels with each other, so as to enable them to vibrate, and to adapt themselves to the curves and undulations of the road, by the combined action of the pins or pivots, the vibrating bars, with the box and the boxes, and plummer blocks of the axles, with their cylindrical fittings, the whole being constructed, combined, and arranged substantially in the manner set forth, the respective parts co-operating with each other upon the principle, or in the manner above made known and described."

French Patents.—By a decree of the French Government, published in the *Moniteur* of the 26th Oct., the law of the 5th July, 1844, on patents for inventions, is to be extended to all French colonies from the date of the present decree.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Alfred Vincent Newton, of 66, Chancery-lane, mechanical draughtsman, for certain improvements in the manufacture of steel. November 2; six months.

Charles William Kesselmeyer, of Manchester, warehouseman, and Thomas Mellodew, of Oldham, in the same county, for certain improvements in the manufacture of velvets, velveteens, and other similar fabrics. November 2; six months.

Charles Dawson, of Hardinge-street, Islington, professor of music, for certain improvements in musical instruments, and in apparatus to be used in connection with musical instruments. November 2; six months.

Robert Thomson Pattison, of Glasgow, Scotland, printer, for an improved preparation or material for fixing paint or pigment colours on cotton, linen, woollen, silk, and other woven fabrics. November 2; six months.

James Hart, of Bermondsey-square, engineer, for improvements in machinery for manufacturing bricks and tiles, parts of which machinery are applicable to moulding other substances. November 2; six months.

William Weild, of Manchester, mechanical draughtsman, for certain improvements in machinery for spinning cotton and other fibrous substances. November 2; six months.

Richard Bright, of Bruton-street, Middlesex, lamp manufacturer, for improvements in lamps, wicks, and covers for vessels for holding oil and other fluids. November 2; six months.

Robert Walter Winfield, of Birmingham, manufacturer, for certain improvements in the construction and manufacture of metallic bedsteads, couches, and sofas. November 2; six months.

John Harris, of Richard's-terrace, Rotherhithe, Surrey, engineer, for a mode or modes of founding type, and of casting in metal, plaster, and certain materials. November 2; six months.

James Robertson, of Liverpool, cooper, for a mode or modes of consuming smoke and other gaseous products arising from fuel and other substances. November 2; six months.

Richard Archibald Brooman, of Fleet-street, London, gentleman, for certain improvements in

the manufacture of hinges, and the machinery or apparatus used therein. (Communication.) November 2; six months.

William Bullock Tibbits, of Braunston, Northampton, gentleman, for improvements in obtaining applying, and controlling motive power, parts of which improvements are applicable to the raising and forcing of liquids. November 2; six months.

Francis Gybbon Spilsbury, of St. John's Wood, gentleman, for improvements in paints and pigments. November 2; six months.

George Arthur Biddle, of Ipswich, engineer, for improvements applicable to gas-burners. November 2; six months.

Meyer Jacobs, of Spitalfields, Middlesex, gentleman, for certain improvements in the manufacture, stamping, and treatment generally of woven fabrics of all kinds. November 2; six months.

Thomas John Knowlys, of Heysham Tower, near Lancaster, Esq., for improvements in the application, removal, and compression of atmospheric air. November 2; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Oct. 26	1642	Richard Walker	Birmingham	Fastening for dress.
27	1643	William Bowler	Manchester	Ventilation hat tip.
28	1644	John Mather	Newcastle-on-Tyne	Stove.
„	1645	William Edward Jenkins	Broad-street, Golden-square	Preserver envelope.
31	1646	W. Burbury	Leamington	Safety carriage, to prevent horses from falling.
„	1647	Richard Eede Marshall	Cheltenham	Clip and file for holding letters, papers, and pamphlets.

NOTICES TO CORRESPONDENTS.

A stamped edition of the Mechanics' Magazine, to go by post, price 4d., is published every Friday, at 4 o'clock, p.m., precisely, and contains the New Patents sealed, and Articles of Utility registered during each week, up to the time of going to press. Subscriptions to be paid in advance. Per annum 17s. 4d., half-yearly 8s. 8d., quarterly 4s. 4d. Post-office Orders to be made payable at the Strand Office, to Joseph Clinton Robertson, of 166, Fleet-street.

CONTENTS OF THIS NUMBER.

Erratum.—For "Thos. Archer," p.430, *read* "Thos. Andrews."

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MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1318.] SATURDAY, NOVEMBER 11, 1848. [Price 3*d*., Stamped, 4*d*.

Edited by J. C. Robertson, 166, Fleet-street.

DAVIES'S PATENT ROTARY ENGINE.

Fig. 1.

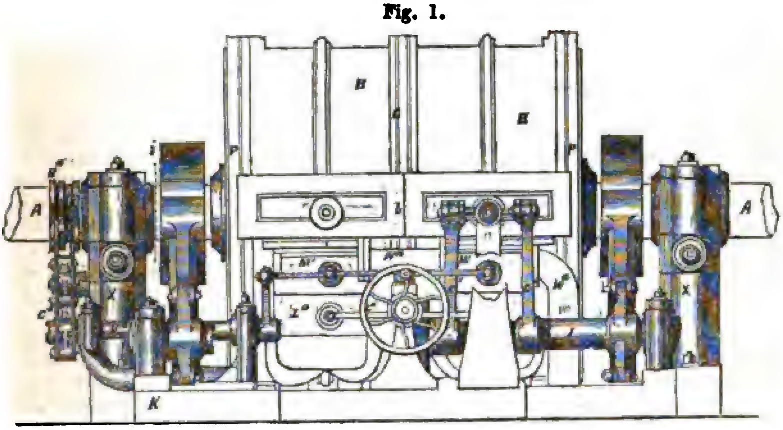
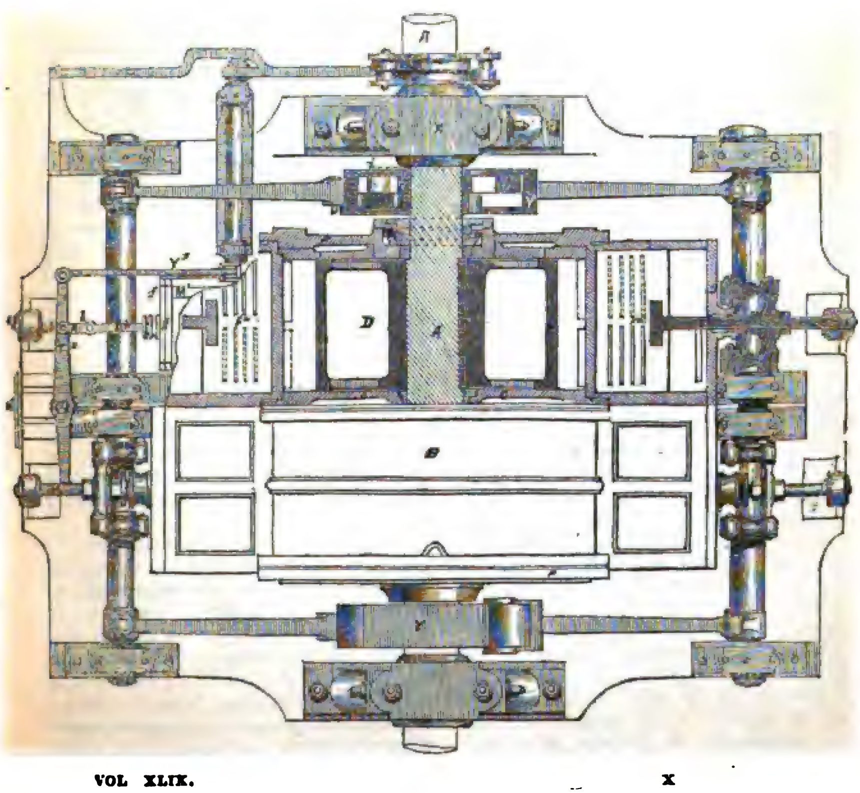


Fig. 2.



DAVIES'S PATENT ROTARY ENGINE, STEAM-PROOF METALLIC PACKING, ETC.

(Continued from page 436.)

The standard bearings, X X, of the main shaft are so constructed as to admit readily of re-adjustment from time to time, so that in the event of any deviation of the shaft from the perfect concentricity which it should preserve, this can be at once detected and the necessary remedy applied. An end elevation of one of these standard bearings, X X, is given separately in fig. 14[a], a plan in fig. 14[b] and the line *a b*, and in a section in fig. 14[c] on the line *c d*. $M^g N^g$ are brass bearings in which the shaft immediately rests. O^g is an iron lining plate which is inserted beneath the under brass bearing, N^g. R^g is a wedge-shaped cotter, which is passed transversely through and through the neck of the standard, and secured at the two ends by the collars and nuts, $S^g S^g$. Should, therefore, the brass bearing, N^g, or the lining plate, O^g, at any time drop out of the horizontal line, it is only necessary to push the cotter inwards, in order to restore the bearing parts to the exact level. T^g is an index or pointer, by which it is easy to ascertain at any time whether the shaft is working truly. On turning this pointer round it should, if the shaft is in its proper position, pass just free of the shaft without touching; but if it comes in contact with the shaft, it is a sure indication that the shaft has dropped out of its proper level, and requires to be re-adjusted by means of the cotter and nuts as has been just explained.

In Mr. Davies's rotary engine, as originally constructed, and as described in the specification of his former letters patent, the cylindrical piston, D, had but one lateral projection or abutment for the steam to act against, but he now makes it with two such projections or abutments, $s^a s^a$, as represented in fig. 3, (see *ante*, p. 433,) or in other words, the piston from being single acting is changed into double acting. The steam is thus made to act on opposite sides of the shaft at one and the same time, so that any tendency which the pressure of the steam on a single abutment at one side of the shaft might have to press the shaft from out of the centre of the fixed cylinder, B, is balanced by the equal pressure on the second abutment at the opposite side, and so neutralized. A further advantage resulting from this double action of the piston is, that as the steam has a double area of piston surface to act upon, the power of the engine is considerably increased without any corresponding increase in its bulk and weight. The proper curve to be given to these abutments is dependent on the lines described by the sliding steam stops, and directions for producing these will be afterwards given when treating of these stops. In the apex of each abutment there is a recess, in which a packing-piece, *e'*, is inserted, and behind this packing-piece a blade spring, which presses out the packing against the sides of the fixed cylinder, B, as the piston revolves, and so prevents any escape of the steam between them. To lessen, however, the friction between the packing-pieces and the cylinder, the former are fixed in an oblique position as regards the shaft, as described in the specification of Mr. Davies's former letters patent.

The mode of attaching each piston to the main shaft is as follows: There are three (or any other suitable number) of feathers, *m, m, m*, which are let into the shaft at right angles to it (see figs. 2 and 3) and these feathers fit into grooves in the bosses of the piston, yet not so tightly, but that the shaft is left free to slide endwise to a certain extent through the piston, that is to say the shaft may slide a little, though the piston itself must always rotate in one and the same plane. The main advantage attending this arrangement is, that should there be any end pressure on the main shaft, as not unfrequently happens, the shaft can yield sufficiently to that end pressure, to prevent any portion of the disturbing force from being communicated to the piston, whereby one of the main sources of friction in rotary engines is entirely removed.

As the piston has two abutments or points of action, so also are there two passages, A′A′, for the admission of steam into the cylinder, B, and also two sliding stops, $F^a F^a$, for letting on and cutting off the steam. On the steam coming from the boiler it flows along the pipe, W^a, (see fig. 1) into the chamber, M′, (containing the expansion apparatus afterwards described) from which

it passes into the chamber, Z^a, whence it is transmitted through one or other of three orifices, q', r', s', according to which of these orifices is left open by the starting, stopping, and reversing valve, which is worked by the hand-wheel, L^a, which acts simultaneously upon the reversing valves of both cylinders.

Fig. 14^a.

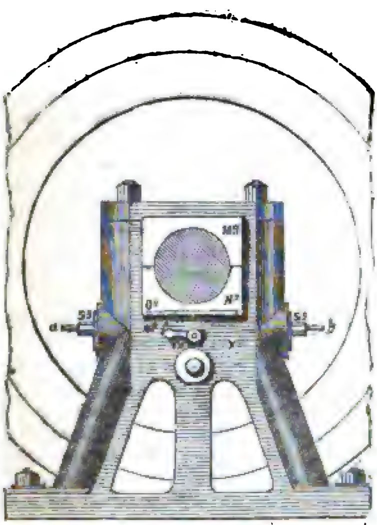


Fig. 14^b.

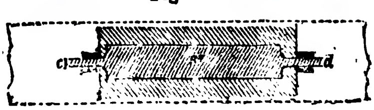
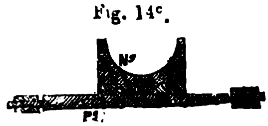


Fig. 14^c.



Supposing the orifice, q', to be that left open as represented in the engraving, fig. 3 (which is the orifice for starting the engine), the steam passing through q enters the pipes, O′O′, and passes thence through orifices into the chambers, G^aG^a (one on each side of the cylinder), from which it passes through slots or ports in the partition plates, b^a b^a, and along channels, AA, in the slide, F^a, into the cylinder, B, where coming in contact with the two abutments, s^as^a, of the cylindrical piston, D, it carries the piston round in the direction indicated by the arrows. Or supposing it is required to reverse the engine, then the orifice, s', is that which is left open, and the steam takes a similar course (but through different passages not shown in the figures) as in the case of starting the engine. During the time the piston abutments, s^a s^a, are passing the passages, A′A′, the sliding stops, F^aF^a, must of course be wholly withdrawn within the chamber, G^a. And so also when the sliding stops are protruded across the annular spaces, H^aH^a, between the piston and the cylinder, B, the mortices in the sliding stops must coincide with the ports in the partition plates, b^ab^a; but a movement equivalent to one of the ports, at once seals the ports and prevents a further flow of steam to or from the cylinder until after the piston has passed and the stop again crosses the annular space.

(*To be continued.*)

FRASER'S ELECTRO-MAGNETIC ENGINE.

Sir,—I have pleasure in replying to Mr. Fraser's communication of the 23rd ult. in the same spirit in which he has noticed my strictures on his former letter. At the same time I must be plain in pointing out what I conceive to be erroneous in his deductions, for it is always a source of regret to those, who like myself are habituated in the every-day course of our professional avocations, to reduce every mechanical project to some practical calculation, to see a talented and ingenious person of another profession, spending time, money, and talents on some "favourite scheme" which could not by any possibility be brought into ordinary use.

I shall allude to a few points in Mr. Fraser's letter in the order in which I find them, premising that I have no particular partiality for any plan of electro-magnetic motion that I have yet seen.

I entirely object to the term "theoretical results" as applied to my calculations. In mechanics there are *practical* calculations founded on known data Thus, if I have given the are of a steam piston, and the intended pressure

of steam, I know what the result will be, though the two have only an imaginary existence. In like manner, having the effective force of two magnets given, it is a mere practical calculation which is required, to ascertain the power to be obtained from a certain combination of such, due allowance being of course made for friction and other known resistances. But in the case of Mr. Fraser's engine, taken in its most favourable condition, it is impossible to obtain any satisfactory results, since it requires only a simple calculation to show that an enormous number of magnets, vibrating at a greater speed than is known by experience to be practicable, would yet afford only a trifling amount of effective power. By Mr. Fraser's own calculations (which I shall presently show, would not hold good *practically*,) it would take *no less than* 10,560 *magnets to produce one horse-power*, supposing the rapid number of 150 vibrations of the sets of magnets in a minute, and exclusive of friction; and no ingenious mechanic could by any possible arrangement obtain even so favourable a result as this. This brings me to the statement of the alleged deficiency of power of those machines made on the common rotary plan. To this I must reply, first, that Mr. Fraser's mode of testing the power of the rotary engine, though an apparently accurate and conclusive one to a person who is not, as he admits, a practical mechanician, is far from being a correct method—and, secondly, he must be unaware of the actual results which have been obtained from such engines for some years past.

First, then, it is a well-known mechanical truth, that a trifling power with a great speed is equal in effect to a far greater power, at a proportionably less velocity. In the rotary magnetic engine the actual power in operation at the extremity of the revolving magnets is but trifling—say from 3 or 4 lbs. to 8 or 10 lbs., but the effect is produced from the great distance through which that power travels in a minute. Whilst it would be perfectly easy to arrest the magnets by the hand, the power of the machine, if conveyed by suitable gearing, to a shaft revolving at a slower rate, might be very great, and applicable to many purposes. And, secondly, this power so reduced in speed, *has been* successfully applied by Professor Jacobi to the propulsion of a large boat, containing four persons, with but a moderate-sized battery, at four miles an hour, and in America to working a turning lathe, &c. In Scotland, also, a magnetic locomotive was constructed which propelled a light weight at three or four miles an hour. These performances are not, I admit, very encouraging, but I mention them to show that more progress has been made in electro-motion than your correspondent appears to be aware of.

The objection as regards the retention of the current *may* not be so great when it is suspended merely, and not reversed. I am not at all sure of this however, since its retention in the arrangement suggested by Mr. Fraser would prevent the separation which is required after each act of attraction. I need scarcely remark that the "comparatively slow motion" alluded to as an advantage, is the strongest possible objection that could be raised.

After a careful consideration of your correspondent's two letters, I confess I cannot at all coincide with him in his opinion that any advantage is to be gained by an imitation of nature, and I believe that the sooner he relinquishes the supposed analogy between the action of the muscles and that of an electro-motive engine, the sooner he will be convinced by a few short and simple calculations, that his arrangement would not answer in practice. His remedy for the resistance of the wire, which he deduces from considerations of this kind, viz., "adding several more batteries," is (if he will excuse my straightforwardness) the most unpractical that could have been named. The very objection to the employment of electro-magnetism as a motive power consists, not in its impossibility, (since it is at once seen that by a multiplication to any extent of the magnets and batteries any amount of power is obtainable,) but it is the *cost* of the battery power which makes its adoption economically out of the question. The same objection also does not, as stated, apply "to any other kind of electro-motive machine whatever," simply because Mr. Fraser's plan requiring at least 10,000 magnets to produce one horse-power, would also necessitate perhaps 500 times the length of copper wire of

an ordinary rotary engine of that power, and consequently a *vastly* increased expense of battery power.

Is your correspondent right in saying that galvanic power *accumulates* in the battery, and is discharged with more effect if its action (*i. e.* change of direction or suspension,) be less rapid? I apprehend this to be an error, but shall be very glad if any of your readers, conversant with batteries as applied to the transmission of a current through wires, will set me right if I am wrong.

In reference to the applicability of Mr. Fraser's arrangement to the propulsion of machinery, I would ask any of your practical readers how they would transmit the forces of 100 sets of 96 magnets to a crank or fly-wheel, recollecting that the first moving magnet in each set or column moves through one-twelfth of an inch, the second two-twelfths, the third three-twelfths, and so on to the last, which moves 8 inches. I am sure they will agree with me in thinking that it would be *incomparably* more difficult than the ordinary rotary plan—in short, that it would be practically *impossible*.

In conclusion, I would respectfully suggest, that Mr. Fraser in endeavouring to work out an ingenious theory founded on laws of the human system (as to which I am quite incapable of venturing a remark) has overlooked the absolute necessity of putting pen to paper, and calculating on the ordinary plan, the theoretical mechanical effect of any arrangement, even under its most advantageous form; and if the practical results of the rotary plan fall so far short (as he supposes) of the theoretical, it may also be conceded that a similar deduction should be made in the estimate of so complicated a method as that of his invention. Another important point to be remembered is that a small power moving through a considerable space, is infinitely superior to an immense power with a very slow motion. 1st. Because the expense of the machine is much less. 2nd. Its weight and complexity are proportionately diminished. And, 3rd, by far the most important, the cost of working it is lessened in a like proportion.

In electro-magnetic motion, the desiderata are these: The smallest possible number of parts (magnets, &c.,) moving at the greatest possible speed, with the smallest possible length of copper wire, and *consequently* of battery power, and therefore the smallest attainable consumption of fuel (metal and acid) or in other words the least possible expense of working. The *principle* of your correspondent's arrangement involving, as I hope I have shown, a violation of almost every one of these requisites, there does not appear in my estimation any reason for hoping, that any possible adaptation of that principle, however ingenious, will prove of practical use.

I am, Sir, yours, &c.,
F. F.

Newport, November 4, 1848.

COLLATERAL USES TO WHICH SEA WALLS MAY BE APPLIED.

It is not usual to obtain collateral uses from those costly works, river or sea walls; yet there are few cases where this might not be effected so as to compensate for a great part of the expense of such structures.

In the instance of the sea wall formed on buoyant masses at Sheerness, Sir Samuel Bentham's intention was to cover them over with an inverted arch of brick, after filling them in with cheap indurating materials to about low-water mark, and above that height to employ the cavities of the wall for useful purposes. He had received the commands of the Admiralty to provide accommodations there for the victualling and other departments, as well as for the dockyard; and, in consequence, designed that wharf for the delivery of supplies of victualling stores without the intervention of small craft, even to the largest ships. The cavities in the wharf wall, were therefore appropriated as store cellars for beer, wine, &c., these cellars extending backwards to the old sea wall, to be arranged either with or without open areas between them, and communicating one with the other or not, as most suitable to the uses for which they were respectively destined.

In the cavities of the walls in the dock-yard Sir Samuel proposed to form "store cellars for pitch, tar, rosin, oils, and other particularly inflammable stores, as also for coals, &c."* There were also to be "covered receptacles for all the boats required to be kept in constant readiness

* Letter to the Navy Board, February, 1812.

for instantaneous use." Also "detached cavities in the wharf walls for heating pitch, charring wood, and for impregnating it with preservative materials, and for other operations from which accidents from fire are particularly to be apprehended." "In some cases the height of the wall above low water would admit of two stories between the surface of the floor and the ground line of the wharf."

Sir Samuel Bentham the more confidently designed this extensive use of cavities in the wharf walling, from the experience obtained in Portsmouth dock-yard, where, according to his proposal, the useless upper part of the great reservoir had been arched over above the water to the level of the yard, and the cellars thus obtained being perfectly ventilated, were employed for a variety of purposes; amongst others, for carrying on experiments in dessicating wood—a proof of their being dry.

In private undertakings, a similar appropriation of the upper parts of sea and river walls, would compensate for great part of the expense incurred in their construction. Thus the rents of cellars in an embankment of the Thames might be made to return a fair interest for capital sunk on the work. Besides this, immense security would thus be afforded against conflagration, since any store that might take fire could be inundated either from the river itself or from adjacent pipes of water companies.

In constructing the masses at Sheerness, it was ascertained that the materials could be most economically disposed in masses of 24 instead of 21 feet base; as these greater dimensions would afford a considerable increase of stowage room; and, in some cases, it would be advantageous to give the backs, at least, a circular form.

The making the cavity above each mass, in many cases, a separate storehouse, he considered highly advantageous, as facilitating at any time an ascertainment of the quantities of articles in store. Indeed, this recommendation in regard to the storehouses of naval arsenals is equally desirable in extensive private storehouses, namely, "that the receptacles for all descriptions of stores be contrived in such manner as that the several articles may be deposited, or taken out (as far as possible), each article, or each package of articles, separately, without disarrangement of the rest; and so that their condition and quantities may, in a great degree, be inspected and ascertained without removal, and this in the case of the most unwieldy stores, not less than of the small ones."*

It is the want of such arrangements in the storehouses of our dock-yards, which constitutes the great impediment to taking stock in them.

November 1, 1848.

MATHEMATICAL RECREATIONS SIMPLIFIED.

Sir,—There is a class of exercises which appear, at first sight, to be very difficult of solution, but which, I shall endeavour to show, are of very easy solution. If I give a few examples, and answer them myself, there will be this double advantage attending the plan: it will prevent your readers from puzzling themselves, and occupy less space in your columns.

Example 1.—What will be the size of a farm lying in a square, that shall contain one rood of land to 5½ yards of outside fencing?

Answer.—5½ yards is one rod; and there will be 40 units of surface measure to one unit of side measure, and $40 \times 4 = 160$ rods the length of one side.

Example 2.—What will be the side of a square inclosure, that shall cost as much fencing at 1s. 3d. a rod as seeding the land did at 13s. 4d. per acre?

Answer.—Here the seeding will be one penny the rod, and there will be 15 units of surface measure to one unit of side measure, $\therefore 15 \times 4 = 60$ rods, the length of the side of the field.

Example 3.—Let a number of sovereigns be placed round the sides of a square, in such a way that there shall be one sovereign to every inch of perimeter; then let two shillings be placed upon every square inch of surface. What will be the side of the square that there may be exactly shillings enough to give full change for all the sovereigns?

Answer.—It is very clear that here is 10 units of surface to one unit of side measure, $\therefore 10 \times 4 = 40$ inches, the length of the side.

Now, Mr. Editor, if you will draw the square upon your library table, then "fork out" 160 sovereigns and 3,600

* Sir Samuel Bentham's "Desiderata in a Naval Arsenal, February, 1812.

shillings, you may readily prove the truth of this by laying down the cash: it would be the best demonstration that was ever given to a problem.

It will now appear that the simple figure 4 may always be used as a multiplier in all similar examples, relating to the square; indeed, the magic influence of this figure render all such exercises so easy, that they might be introduced into a chapter of mental arithmetic.

All similar examples relating to the trigon, admit of an equally easy solution if we use the number 6·9284 as a constant multiplier. Take a well known example from Hutton.

Example 4.—What will be the side of an equilateral triangle whose area cost as much paving at 8d. a foot as pallisading the three sides did at a guinea a yard?

Answer.—Here the prices are 84d. a foot and 8d. a foot, and we obtain $10\frac{1}{2}$ of surface measure to one of side measure, $\therefore 10{\cdot}5 \times 6{\cdot}9284 = 72{\cdot}75$ feet nearly, the length of the side, and $72{\cdot}75^2 \times 0{\cdot}433 = 2291{\cdot}68$ the area.

I am no disciple of Euclid, capable of developing things by the power of my own natural genius; it is Hutton's own solution of the last example (page 114) that has made me so figure wise upon the subject. — *Hutton's Mensuration*, large edition, 1802. Is there a later edition? I. L.

Wolverton, November 4, 1848.

ON CONGENERIC SURD EQUATIONS. BY PROFESSOR YOUNG.

In Number 1314 of this Magazine is an interesting and original paper on this subject by my esteemed friend, Mr. Cockle, in which a doubt is expressed as to the accuracy of the solution given to a certain surd equation in my elementary work on algebra. The only objection to Mr. Cockle's amendment seems to be, as that gentleman has noticed, that it would imply the admissibility of the equation $-0 = +0$. With all becoming deference, this condition is, I think, fatal to the proposed alteration; for, by taking the reciprocal, we should be obliged to admit this other condition: $-\infty = +0$, and, therefore, by transposing, that $0 = 2\infty$, which is, of course, erroneous. Moreover, if the root $x = 5$ be considered to belong to each of the congeneric surd equations into which the rational quadratic may be decomposed, then, as this quadratic has also the root $x = 3\frac{1}{2}$, it would, in all, have *three* roots, viz. 5, 5, and $3\frac{1}{2}$.

Mr. Cockle's remarks have led me to think that the following theorems might be considered as not superfluous additions, although, comparatively, very trifling ones, to the theory of congeneric surd equations, which Mr. Cockle has so fully and ably discussed in the pages of this Journal:—

1. If one of the two quadratic surd congeners have two roots, the other will have no root.

2. If one have but a single root, the other will have but a single root.

3. The roots furnished by a pair of congeners can never be equal.

The first two of these follow from the fact, that the rational quadratic, furnished by the product of the congeneric pair, must have two roots, and only two.

The third is an inference from the truth, that a quadratic which has equal roots must have *rational* factors.

In connection with this subject, I may add, that the theory of congeneric equations suggests a much more fitting appropriation for the term *imaginary roots* than its usual application is. Mr. Cockle has clearly perceived this, and has proposed to change the term *imaginary*, as commonly used, for the term *unreal;* and to employ the former only in reference to those rootless equations which the present theory has brought under consideration. The change appears to me to be in every respect worthy of general adoption. The things hitherto called imaginary roots may often, as I have elsewhere shown, be replaced by real values—values which, although not, in strictness, approximations to the so-called imaginary roots, are, nevertheless, approximate solutions to the equation, or rather, accurate solutions to an approximate equation; and, therefore, as admissible, and, on the same ground, as approximate values in all mathematical inquiries.* This circumstance alone would seem to justify the abandonment of the designation *imaginary roots*, if, as is customary, it be understood that an equation, having such roots only, admits of no approximate solution. In the changed nomenclature, only *rootless*

* See "Theory and Solution of Equations," second edition, page 311.

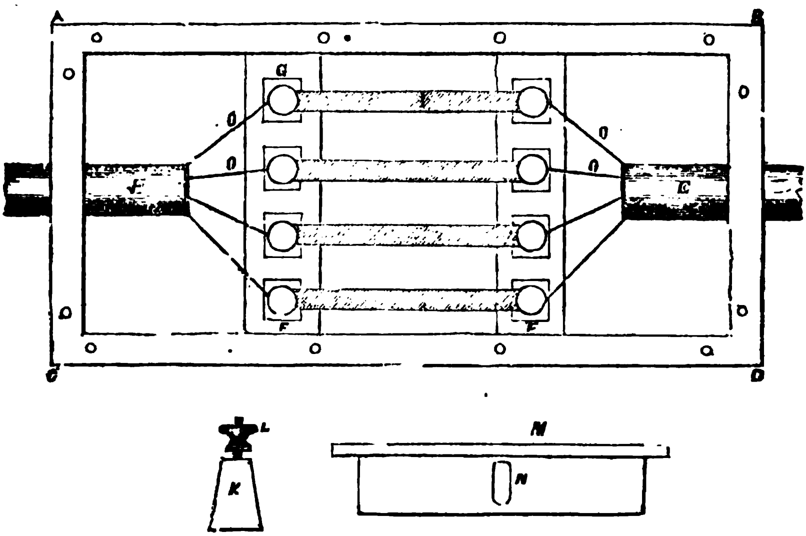
equations would be said—using an affirmative form of expression—to have imaginary roots.

I cannot but think that, previously to the discussions of Mr. Horner and Mr. Cockle, in reference to congeneric equations, our knowledge of the constitution of equations could scarcely be said to have been complete. Most persons would have demurred to the proposition which affirmed that certain rational equations, of the nth degree, might be decomposed into n equations of the first degree in more ways than one:—that two sets of n factors of the first degree, entirely different, might exist, which nevertheless would, upon being severally equated to zero, furnish the same series of roots. Yet the statement is true, if we regard that equation or factor to be of the first degree which has only one root.

Before terminating this brief communication, candour compels me to admit that the arguments I have used above against the admissibility of the equation $-0=+0$, in the case before us, may possibly be met by serious objections. I give them here as those which I believe prevailed with me at the time of writing out the solution referred to; but I record them with some degree of misgiving, and am willing to believe that the theorem 3, above, may be shown to be untenable when, as in the present example, the value of x is such as to cause the irrational part of the congener to vanish, as well as the rational part. In my own mind, therefore, I wish it to be understood that the point mooted remains in some measure in abeyance. It is proper, further, to add, that although, as noticed above, the first discussion of this class of equations, after the mere passing notice of Garnier, was by Mr. Horner, yet I believe that that discussion originated with and was suggested by Professor Davies.

Belfast, November 3, 1848.

TESTING-BOX FOR ELECTRIC TELEGRAPH UNDER-GROUND TUBES.



Sir,—I beg leave to lay before your readers a new description of testing-box, which may be used advantageously in connection with the earthenware tubes lately patented by Mr. Whishaw, for conveying telegraphic wires under ground, or it may be used in like manner with the wires contained in gutta percha tubes, described in my letter published in No. 1310 of the *Mechanics' Magazine*. A, B, C, D is a trough of earthenware, of any convenient size, and about six inches deep, having a flange round the edge. EE are the tubes containing the

wires, and passing through a hole at each end of the trough. FF are bridges rising from the bottom of the box, having any number of holes, G, for the reception of a brass screw, K, which is to be fixed in cement; H is the top of the screw. The wires, OO, are attached to the screws, and connected with wires at the other end of the box by the brass bands, I. The cover of the box is also of earthenware, and secured with cement or otherwise.

M is the end of the box, having a hole, N, through which the tube, containing the wires, passes, and is secured and rendered water-tight by cement.

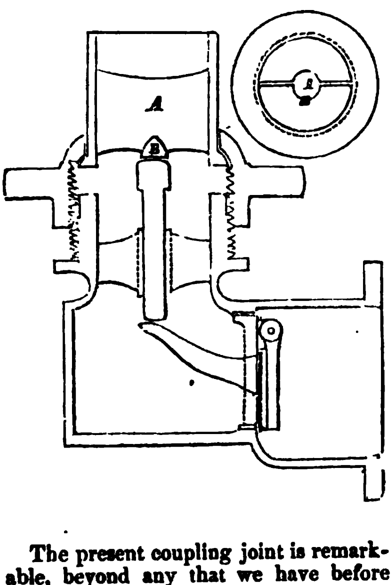
The peculiar advantage of this construction is, that the whole of the material is a non-conductor, except that part which is necessary for continuity, and that all danger of earth contacts is removed.

I am, Sir, yours, &c.,
J. H. Hammerton.

Brixton, October 10, 1848.

MESSRS. RONTREE AND BROWN'S SCREW UNION JOINT FOR WATER PIPES.

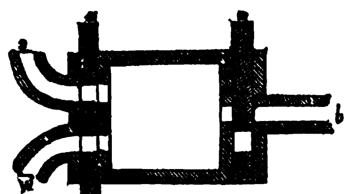
[Registered under the Act for the Protection of Articles of Utility.]



The present coupling joint is remarkable, beyond any that we have before met with, for combining great simplicity with quickness and certainty of operation. The ends of the supply and delivery pipes are connected by a screw coupling, as usual; but there is inserted in the end of the supply pipe a midfeather, A, with a projecting knob, B, as shown in the prefixed figures. On turning the coupling in one direction, the knob, B, presses on the top of the spindle of the valve in the supply pipe, and thereby opens the valve; and on turning it the reverse way, the valve is as instantly closed.

A correspondent, who has had one of these union joints in use, writes to us in these terms:—"It answers admirably. The youngest boy in the works can now open the hose in the dark, and have water in a minute or two. Nothing could possibly be more effective. The weight of the whole, including the valve, is only 7½ lbs. for a two-inch jet, and the expense a mere trifle."

BOILER REGULATORS.—MR. BADDELEY'S AND MR. MOY'S INVENTIONS.



Sir,—I should have remained ignorant of Mr. Baddeley's invention but for his communication inserted in your last Number (1317). As it is probable that many of your readers, like myself, may not happen to possess your Magazine so far back as the 21st vol., I send you a sketch of Mr. Baddeley's substitute for a feed pump inserted in that volume, leaving it to your readers to decide which has the best claim, to the invention of a good, practical, and efficient, regulator for the supply of water to steam boilers. *a a*, are two slides, to which a reciprocating motion is given, alternately opening and cutting off the respective communications with the boiler and supply; *s* and *w* are two pipes leading to the boiler, one above, and the other below, the water line; *b* is the supply pipe.

I remain, Sir, yours, &c.
T. Moy.

1, Clifford's-Inn, Nov. 7, 1848.

PRESSURE OF THE EARTH AGAINST REVETEMENT WALLS.

Sir,—In Moseley's "Mechanical Principles of Engineering and Architecture," page 443, article 321, the author, speaking of the pressure of earth against revetement walls, proves very satisfactorily that, in the case where the wall is vertical, and the surface of the earth horizontal, that that pressure is represented by the maximum value of P with respect to i in the equation

$$P = \tfrac{1}{2}\,\mu.\,x^2.\,\tan i.\,\cot(i+\phi).$$

P representing the pressure of the earth, μ the weight of a cubic foot of earth, x the distance from the surface of the earth to the foot of the plane of incidence, i the angle between the vertical and the plane of incidence, and ϕ the limiting angle of resistance. Now my difficulty is, that the author asserts that

$$\frac{dP}{di} = \tfrac{1}{2}\,\mu,\ x^2\,\frac{\sin 2\,(i+\phi) - \sin 2\,i}{\cos^2 i.\ \sin^2 (i+\phi)},$$

the reason of which I cannot see; for surely the differential coefficient of cot. $(i+\phi)$ cannot be

$$-\frac{1}{\sin^2 (i+\phi)},$$

as ϕ is a constant; and, to make the matter worse, in the next article, when proceeding to find the maximum value of P in the equation

$$P = \tfrac{1}{2}\,\mu,\ x^2\ \frac{\cot\,(i+\phi)}{\cot\ i + \cot\ \beta},$$

he says, "Expanding cot $(i+\phi)$, and differentiating in respect to tan i," &c.

Why does he expand cot $(i+\phi)$ in this case, and not in the last? and why in in this case does he differentiate with respect to tan i, and in the last with respect to i.

Hoping that some of your many able mathematical correspondents will be so good as to satisfy these doubts,

I am, Sir, yours, &c.,
A CONSTANT READER.

November 6, 1848.

THE REMARKABLE ACCIDENT AT THE BLASTING FURNACE, MERTHYR TYDVIL.

Sir,—The incident mentioned by "An Old Subscriber" as happening at Merthyr Tydvil is so curious that I must trouble him to describe the circumstances a little more precisely and minutely. For instance. Was the 12-inch stop valve seated in an air pipe leading *to* or *from* the hot-air stove? Or was it placed in a cross-pipe, intended to transmit the cold blast to the furnace in case of accident to the stove or heating apparatus? What is meant by the "waste" out of which the "flame" escaped? Or, is it a bye-flow for a part of the blast, the blowing engine still working during the stoppage of the blast flow, whilst the furnace is tapped, dammed and timped? Was it at the furnace-fall that the materials were *belched out?* Were the nozzles still in the tuyeres, and close stopped? And was the crucible of the furnace continuously connected without obstacle with the entire length of hot air pipes? Is the main pipe subservient to the purpose of leading the blast from the equalizing chamber to the furnaces, and branching off at right angles to be afterwards divided, and subdivided, into 12 or 15 inch service pipes to the hot-air stoves? How long had the hot-air pipes been in use? What is the cement they are jointed with, and will it stand a red heat without decomposition? *Of what colour was the flame that escaped at the waste?* When the blast is shut off, can so much as a breath of air pass to the furnace? Is the stop-valve alluded to, a disc with a turned bevel edge, fitted accurately into a bevelled seating?

These queries being accurately answered, will enable a correct opinion to be given on so mysterious yet important an accident. Nothing that occurs about an iron stack is too trivial, and, if I mistake not, the germ of a most important secret is kernelled in this remarkable phenomenon.

WM. RADLEY,
Chemical Engineer.

November 1, 1848.

SAFETY GUN LOCK.

Sir,—Observing recently an advertisement of a safety gun-lock, patented by *Mr. K. Baker, St. James-street, London*, I am induced to trouble you again with a subject, concerning which I sent you a letter in the spring of 1845, but which was not inserted in the *Mechanics' Magazine*.* The invention I then de-

* We perfectly remember receiving this letter, but our reason for not inserting it was the great indistinctness of the sketches which accompanied it. Those now sent are intelligible enough.—ED. M. M.

scribed resembled so closely, both in its object and means, that I have just seen published, that I shall consider, if the patent is of recent date, (and I never heard of anything of the kind before,) that the right of priority of invention is mine. However, be that as it may, I beg leave to lay before you again a short description of my apparatus, as it appears to me to be very much simpler, and perhaps safer in action, than that described by the patentee.

It may, then, be briefly described thus. Its object is to prevent the accidental explosion of fire-arms, and fowling-pieces especially, from being left on full cock. On the new plan, they can be left in this state without the least danger, and thus the tedious operation of cocking, immediately before firing, will be dispensed with. For this purpose, a sliding-bolt is contrived so as to *lock* the trigger or triggers (for one bolt is sufficient, whether the piece be single or double-barreled). This bolt, which is inserted behind the lock-plate, may be pressed inwards by the thumb, which *naturally* falls in that position in firing. On being thus pressed, it is, as it were, thrown out of gear with the triggers, which are thus free, and able to be pulled. If, however, the instant before firing, the sportsman may have changed his mind, or the game escaped, he will not, as according to the present system, hurry off with his gun on full-cock, and wound himself or companion; for this bolt is so contrived, that the instant the pressure of the thumb is removed, it is forced by the recoil of a spring into its former position, and the lock is as safe as before, although it still remains on full-cock. Now, by the patent plan above mentioned, this object is attained by locking, not the triggers, but the tumbler of the lock itself, for which purpose, a plan, much more complicated than mine, combining several joints, levers, &c., is devised, all which will render the first cost great in comparison, and the taking to pieces, oiling, &c., more difficult, than on my plan. To illustrate these remarks, I send you the inclosed sketches, which are very nearly the same I sent you three years ago.

Of these figures, fig. 1 is a side section of a gun-stock, on the line x x, in fig. 2, (the sliding-bolt, *d*, however not being in section). Fig. 2 is a top section on

Fig. 1.

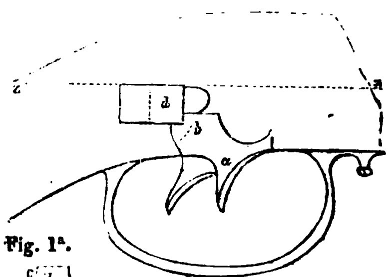


Fig. 1a.

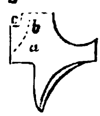


Fig. 2.

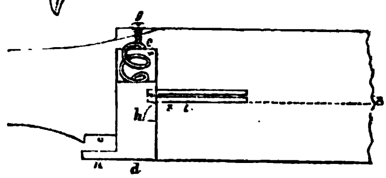
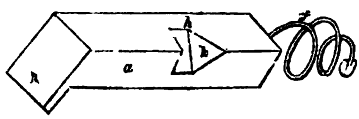


Fig. 3.



the line z z, of fig. 1; *a a* are the triggers, which must be made wider than on the old plan, according to which they would not extend further to the left than the dotted line, *b*. A square notch must be cut out of the corner of *a* at *c*, as will be seen better in the separate view, fig. 1a. This notch fits exactly the under corner of the sliding bolt. This bolt is flush with the lock-plate, and moves up backwards and forwards in the mortice, *d*, *e*; *f* is a spiral spring, which is fixed on to the inner end of *a*, and presses it outwards; the other extremity of this spring is fixed to a stud; this is secured in the mortice by the screw *g*, which being removed, the whole apparatus can be withdrawn to repair or oil. It will be seen, that if the under corner of the bolt, *a*, were *rounded* off, it would no longer lock the triggers; this therefore is done in the part marked *h*,

which is brought exactly to coincide with the triggers, when the bolt is pressed inwards. Fig. 3 is a perspective view of the underside of the sliding-bolt, supposing it to be taken out of the mortice; *h* is the part where the corner is rounded off; at *k* it is gradually inclined upwards for a purpose stated below. Now, on this notch *h* being brought to coincide with the triggers, one or both barrels may be discharged, and, on pressure being removed from the bolt, the spring *f* forces it back into the position, fig. 1, and the incline surface, *k*, in returning, gradually presses back the triggers, which had been pulled back in firing; *n* is a plate fixed on to the outer end of *a*, for the more convenient pressing of it—a cavity, *o*, being provided for its inward motion.

This is my safety gun-lock. The contrivance can, it is obvious, be applied to guns on the ordinary plan, and the cost of the bolt, spring, larger triggers, &c., would be but a trifle.

Hoping that you will give this letter an early insertion in your valuable Magazine, I remain, Sir, yours, &c.

Θεωνδωρον.

October 3, 1848.

HARRILD AND SONS' HAND-PRINTING PRESS.

(Registered under the Act for the Protection of Articles of Utility. Messrs. Harrild and Sons, of Great Distaff-lane, and Friday-street, London, Printers' Roller Makers. Proprietors.)

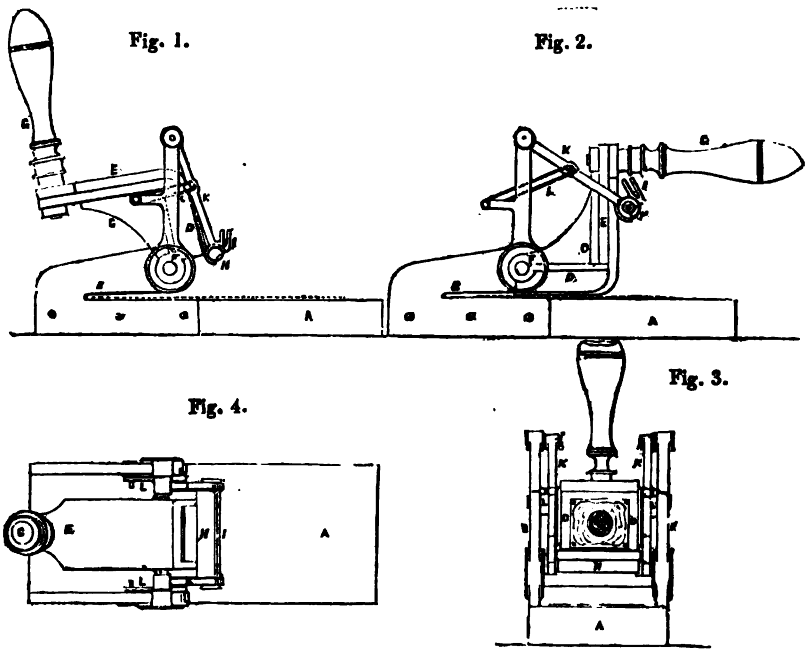


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

Fig. 1 is a side elevation of this very clever press as it appears when at work, and fig. 2 represents it in the act of being employed to make an impression; fig. 3 is an end elevation, and fig. 4, a plan. A A is a basement, to which the two side frames, B B, are securely fixed; C is a casting of metal having two rectangular surfaces, D and E, placed at right angles to one another. The lower surface, D, is the form upon which the types, wood cut, or die, D', is fastened; the

upper surface, E, serves as an inking-table; the casting, C, is attached to the side frames, B B, by a pin or fulcrum, F, upon which it is free to be raised up from or pressed down upon the bed A, by means of the handle, G; H is the inking-roller; I, the distributing roller; these rollers have their bearings in the two arms, K K, which are jointed to the tops of the frames, B B; L L, are bands of vulcanized caoutchouc which keep the inking-roller always either in contact with the inking surface, E, or the types, D, according to the position occupied by the moveable part of the press.

The bill, or other paper, to be printed, is laid upon the basement, A, which is covered with a thin sheet of vulcanized caoutchouc. The inking of the types, or die, and the impression is effected by pressing down the handle, G.

THE "NOTE" TO SIR H. DOUGLAS'S "PROTEST."

Sir,—An "Old Engineer," page 445 (*ante*) is partially right in his reference to *Hutton's Tracts*, vol. i., where the impulse of *a particle* of fluid upon an inclined surface is shown to be as the sine squared of inclination; but if he will only proceed a step further, and integrate the expression for the sum of the partial resistances, he will not fail to find that the *whole* resistance to the plane in the direction of its axis (which, in the case of a breakwater, is horizontal) will come out as the sine *cubed* of inclination.

It occurs to me, that this oversight is the sole cause of difference in the views of your correspondents, as to whether the impulse in direction of motion should be estimated by the *square* or the *cube* of the sine of inclination. Take, for example, the expression $R = n, q, \sin^2 \phi$, in which n is the number of particles which act horizontally upon the plane, q the resistance of one particle estimated parallel to the axis, and ϕ the angle of inclination. Now, without diverting the attention by cavilling as to whether n is a symbol or a factor (perhaps it is both), let me ask—should I be warranted in concluding from this equation that R is as the sine^2 ϕ, while it is clearly competent for me to expand n in terms of ϕ? True, you may consider n constant; but whether it is constant or variable, the equation $n = AB. \sin \phi$ is rigorously true (AB being the length of the plane), and expresses the actual integration of the whole particles which strike the plane. Now, this being a true value of n in every possible case, what grounds can exist for objecting to substitute it for n in the above equation; in which case there will result $R = AB. q. \sin^3 \phi$ for the *whole* resistance in the direction of the axis.

How these results, plain as the alphabet, can be questioned in the face of the authorities cited, and the very opposite maintained with such pertinacity, I cannot imagine. I can assure your correspondent that, for my own part, I am not *unwilling* to see the truth in this matter, and believe it to be palpably plain; but I certainly confess my *inability* to see my way through what appears to me a fruitless attempt at mystification.

Could the "Old Engineer" be prevailed upon to enter on Moseley's 5th chapter (Hydrodynamics) and read on to p. 189, he would find the case in a "nut shell;" or would he be so good as to explain what *Ramsay's Hutton* means in p. 590. I respectfully challenge the "Old Engineer" to produce any one line in these distinguished authors against the principles contended for by me; but there is very little fear that in the present case those authors will be further consulted by your correspondent; and it is a matter not unworthy the exercise of his judgment, whether he is likely to add to his reputation as a man of science by prolonging the discussion of this subject.

It appears to me that the note to art. ii. of the "Protest" inadvertently asserts that the law of resistance developed in terms of the sine of inclination, which is shown by mathematicians to obtain in the case of an element of the fluid, is that which obtains for the whole resistance upon the plane; but the integration of those elements will show that the whole resistance, as compared with the sine of inclination, varies as the *cube* of the latter. How far this *lapsus* in the note affects the subsequent reasoning in the "Protest" it will be for those whom it interests to determine.

I am, Sir, yours, &c.,

RATIO.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, by whom was appointed a sub-committee to examine into the cause of the explosion of a stationary engine in Maiden-street, Philadelphia, on the 2nd of May, 1848.

Report, That the boiler consisted of two concentric cylinders, placed with their axis vertical. The outer one was 10 feet long, and 4 feet in diameter; the inner one was 8 feet long, and 3 feet 7½ inches in diameter. They were made of ¼-inch boiler iron, and were connected together at their lower edges. About 2 feet below the top of the outer cylinder, the inner one was closed by a stout circular head of boiler iron, ¼ inch in thickness, which was connected with the head of the outer cylinder by four double wrought-iron stay-bolts. Through this lower head passed 78 wrought-iron tubes, about 6½ feet long, of which 48 had an internal diameter of 2 inches each, and 30 of 1¼ inches, arranged in concentric circles, around a large central tube of the same length, 7½ inches in internal diameter. They were all closed at their lower ends. These tubes were firmly secured into the head of the inner cylinder at their upper ends, and were suspended from it in the furnace. The furnace consisted of the space inside of the inner cylinder, the lower edge of the fire-door being on the level of the junction of the two cylinders, and the flue or smoke-pipe entering just below the lower head or tube-sheet. It will be seen that the water or steam space consisted of the upper part, about two feet in length, of the outer cylinder, the space between the two cylinders, and the inside of the tubes. There were no stays connecting the two cylinders, except those which have been already mentioned as passing between the two heads. The furnace was interior, and the whole of the surface exposed to the action of heat, with the exception of the areas of the bottoms of the tubes, and the tube sheet, which was far removed from the fire, was arranged vertically. The feed-water was introduced into the space between the two cylinders, about 3 inches above their lower junction, and upon the right side of the fire-door. There were three gauge-cocks in the upper part of the boiler, the lower one of which was disused, having become obstructed; the second was 8 inches above the tube sheet, and the third 7 inches above that. This boiler was usually connected with another horizontal boiler, 13 feet by 3½, consisting of two concentric cylinders, with 10 crossing water tubes, 7 inches in internal diameter. The water spaces of the two boilers were connected below, and a pipe passed from the upper part of the horizontal, into the steam space of the vertical boiler. This boiler was, however, not in use at the time of the accident.

The boiler was thrown nearly vertically upwards, passing through the upper stories of the building, upon the ground floor of which it was placed, and after having risen, according to the evidence of eye-witnesses, to a very great height in the air, fell in the street at a distance of about 70 feet from its point of departure.

Upon examining the boiler, the committee found that the inner cylinder had given way near the bottom. The rivets between the lowest and second sheets had been shorn off, and the line of separation was continued on one side by the tearing of the iron, so as to pass about halfway around the boiler, and at each end of the fracture there was a short tear in a vertical direction. The inner cylinder had been forced in upon the tubes, which were displaced and crowded together, and was folded as shown in the accompanying diagram, which represents the appearance of a cross section made just above the top of the fire-door. The centre of this line of fracture was diametrically opposite to the feed pipe. This yielding of the inner cylinder was less towards the tube sheet, above which the boiler was apparently totally uninjured. It was sufficiently evident then that the boiler had yielded to a strong pressure exerted between the two cylinders, which had forced the inner one, which presented the least resistance, inwards, shearing the rivets by the lateral motion of the boiler plates, and completing the opening for the escape of steam, by tearing the iron itself. The committee had two pieces of the iron cut along the edges of the fracture, one in the direction of the rolling of the iron, the other at right angles to this direction. These pieces being reduced by filing to a proper cross section, were placed in the breaking machine of the Institute, for the purpose of testing their tensile strength. The piece cut in the direction of the grain of the iron broke in the part where it was grasped by the wedges, with a strain of 58,080 lbs. per square inch. As the wedges had marked the surface very deeply, this experiment can only suffice to give the lower limit of its tensile strength, and the committee regret that they could not procure another piece of the iron for the purpose of repeating the experiment. The piece cut across the grain broke with a strain of 60,480 lbs. per square inch. The iron therefore had a strength to

resist tearing very considerably above the average of boiler iron. It however presented a very crystalline fracture, and frequently broke short with the blow of the sledge, which may have been the effect of overheating.

The committee noticed no conclusive marks of overheating upon the iron, but there was a triangular space extending from the bottom of the boiler diametrically opposite the point of introduction of the feed-water, to the insertion of the smoke flue above, in which the whole of the deposit which thinly coated the rest of the boiler was burned off, and the surface was clear.

The circumstances connected with the explosion, as stated by Mr. Miles, the proprietor, were these:—The engine was under the charge of a lad who had always shown himself to be careful and attentive. He was in the habit of filling the boiler with cold water until it began to run from the second gauge cock. The power of the engine was rented out to workmen in the building, and was principally used for turning grindstones. The safety valve was usually loaded to a pressure of 98 lbs. per square inch (and the measurements which the committee were enabled to make, were confirmatory of this part of Mr. Miles' statement.) The accident happened about half an hour before the usual hour for the assembling of the workmen in the morning. Mr. Miles was in the house; as the steam was got up earlier than was necessary, he directed the lad to open the fire-door, and shut off the draught, which was done, and in about three minutes the boiler exploded. It seems, therefore, that the explosion took place upon the reduction of the temperature of the boiler. The force must have been tremendous, but the destruction of the building by fire, and the usual vagueness and inconsistencies of eye-witnesses to such an event, prevent any even approximate calculation of it.

That the explosion of the boiler was not caused by a gradually accumulating pressure arising from the continual formation of steam under a fastened safety valve, the circumstances of the case show. The accident having occurred before the time for commencing work, every even plausible motive for such conduct is removed, and it could scarcely have taken place accidentally under the heavy pressure necessary to produce the effects exhibited. Besides, the occurrence of the explosion upon the reduction of the heat of the furnace, appears to the committee perfectly conclusive against this supposition.

That the boiler did not explode from carelessness in supplying it with a proper quantity of water, is rendered probable by the testimony that the gauge cocks had been shortly before tried, and that a large quantity of water was actually discharged from the boiler at the time of the explosion. The character of the boy who had charge of the boiler, for carefulness, joined with the fact that he was under the immediate inspection of his employer, and the total absence of any conceivable motive for wilful negligence in this regard, should suffice to reject this supposition, if it be possible fairly to account for the explosion otherwise, and the committee believe that a mere glance into the arrangement of the boiler will suffice to show the possibility of such an explanation.

In fact, it appears to the committee hardly possible to devise a boiler of a more dangerous construction. Narrow water spaces, most of them tubular, closed below, and presenting the least advantages for the formation of currents, by means of which water might be continually supplied; the inner cylinder presenting a surface of 90 square feet without a single stay, and exposed to a crushing pressure, so that every change of figure diminishes the resistance to the force of the steam. The experience with locomotive engines shows that it is nearly impossible to keep water in the narrow water spaces which surround their fire-boxes, and these spaces are therefore carefully stayed, while we have here an immense surface exposed to the same source of danger, without any support from the inner shell. The steam space of the boiler, allowing for this purpose the space above the upper gauge-cock, was much too small for a stationary boiler, and the water space, including the interval between the two cylinders, the tubes, and the space above the tube-sheet as far as the upper gauge cock, was singularly small when compared with the external dimensions and amount of material of the boiler. In fact, the whole cubic content of the water room was but 82,535 cubic inches (about 48 cubic feet, or 357 gallons). Nor is the arrangement advisable in an economical point of view, the surface exposed to the action of the fire, and the heated air being almost entirely vertical, would present itself in a disadvantageous position, and the large clear spaces above the fuel, would permit much of the heated air to ascend freely and escape without communicating its heat to the water at all. The boiler therefore could not have been an economical one, and was most undoubtedly in the highest degree unsafe.

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REPORT ON THE EXPLOSION OF A STATIONARY ENGINE.

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The boiler was thrown nearly vertically upwards, passing through the upper stories of the building, upon the ground floor of which it was placed, and after having risen, according to the evidence of eye-witnesses, to a very great height in the air, fell in the street at a distance of about 70 feet from its point of departure.

Upon examining the boiler, the committee found that the inner cylinder had given way near the bottom. The rivets between the lowest and second sheets had been shorn off, and the line of separation was continued on one side by the tearing of the iron, so as to pass about halfway around the boiler, and at each end of the fracture there was a short tear in a vertical direction. The inner cylinder had been forced in upon the tubes, which were displaced and crowded together, and was folded as shown in the accompanying diagram, which represents the appearance of a cross section made just above the top of the fire-door. The centre of this line of fracture was diametrically opposite to the feed pipe. This yielding of the inner cylinder was less towards the tube sheet, above which the boiler was apparently totally uninjured. It was sufficiently evident then that the boiler had yielded to a strong pressure exerted between the two cylinders, which had forced the inner one, which presented the least resistance, inwards, shearing the rivets by the lateral motion of the boiler plates, and completing the opening for the escape of steam, by tearing the iron itself. The committee had two pieces of the iron cut along the edges of the fracture, one in the direction of the rolling of the iron, the other at right angles to this direction. These pieces being reduced by filing to a proper cross section, were placed in the breaking machine of the Institute, for the purpose of testing their tensile strength. The piece cut in the direction of the grain of the iron broke in the part where it was grasped by the wedges, with a strain of 58,080 lbs. per square inch. As the wedges had marked the surface very deeply, this experiment can only suffice to give the lower limit of its tensile strength, and the committee regret that they could not procure another piece of the iron for the purpose of repeating the experiment. The piece cut across the grain broke with a strain of 60,480 lbs. per square inch. The iron therefore had a strength to

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In fact, it appears to the committee hardly possible to devise a boiler of a more dangerous construction. Narrow water spaces, most of them tubular, closed below, and presenting the least advantages for the formation of currents, by means of which water might be continually supplied; the inner cylinder presenting a surface of 90 square feet without a single stay, and exposed to a crushing pressure, so that every change of figure diminishes the resistance to the force of the steam. The experience with locomotive engines shows that it is nearly impossible to keep water in the narrow water spaces which surround their fire-boxes, and these spaces are therefore carefully stayed, while we have here an immense surface exposed to the same source of danger, without any support from the inner shell. The steam space of the boiler, allowing for this purpose the space above the upper gauge-cock, was much too small for a stationary boiler, and the water space, including the interval between the two cylinders, the tubes, and the space above the tube-sheet as far as the upper gauge cock, was singularly small when compared with the external dimensions and amount of material of the boiler. In fact, the whole cubic content of the water room was but 82,535 cubic inches (about 48 cubic feet, or 357 gallons). Nor is the arrangement advisable in an economical point of view, the surface exposed to the action of the fire, and the heated air being almost entirely vertical, would present itself in a disadvantageous position, and the large clear spaces above the fuel, would permit much of the heated air to ascend freely and escape without communicating its heat to the water at all. The boiler therefore could not have been an economical one, and was most undoubtedly in the highest degree unsafe.

The committee believe that the following is the most probable explanation of the catastrophe:—The first effect of the heat would be to expel the water from the water space between the two cylinders and from the

tubes (except the centre one.) This would be easily and efficiently accomplished in consequence of their small diameter, and closed bottoms, with the exception of that part of the water space where the feed was introduced, where there would of course be kept up a continual current of water. The water then being expelled from these spaces, they would soon become very hot, and since, in this condition, the only effective communication between the heat of the fuel and the water above, would be by means of that in the central tube, it would require a considerable time to heat the whole water up to the proper temperature for generating steam of 90 lbs. pressure, and during this time the walls of the empty spaces would become very hot. When the fire door of the furnace was opened, and the draught shut off, the diminution of the heat would soon permit the water to be forced back by the pressure of the steam above it into the spaces before filled with steam only, and this water coming in contact with the highly heated surfaces, would generate suddenly a steam of great pressure, which could not be relieved by the safety valve, and since the action would continue, the boiler must give way, which it would do, by yielding in the weakest direction, that is, by the crushing inwards of the inner cylinder, the bending of which would diminish the resistance to the pressure, and thus the rivets would give way and the iron tear; the water then being suddenly brought into contact with the ignited fuel, a second pressure would be suddenly developed, which finding its point of resistance on the lower side of the tube sheet, would propel the boiler vertically upwards. That the intense pressure was caused by the return of the water upon a surface of suddenly heated metal, is evident from the fact of the explosion having taken place upon the reduction of the temperature of the furnace; and that the tubes and lower water spaces were habitually destitute of water, is evident among other things from the statement made by Mr. Miles to the committee, that when the boiler was filled with cold water as high as the second gauge cock, the expansion upon heating would carry it up to the upper cock before the steam began to blow off, at 95 lbs., and how much higher he did not know. But supposing the boiler filled to the second gauge cock with water at 32°, and then to be heated to 346°, which corresponds to a pressure of 105 lbs. per square inch, and admitting the commonly received coefficient $\frac{1}{23}$ for the expansion of water for 180°, the level of the water would still fall more than 2¼ inches short of the upper gauge cock. This apparent expansion must, therefore, evidently have been due to the removal of the water from the lower part of the boiler.

The committee believe, therefore, that there is no evidence in this case of any neglect in the management of the boiler by Mr. Miles, still less of any fault on the part of the maker, either in the materials, or the workmanship. But that the accident is due entirely to the very faulty plan upon which the boiler was constructed—a plan which is not only very ill-judged in regard to economy, but which is, moreover, so dangerous as to render such a boiler utterly inadmissible in practice, and presentable as a nuisance in the neighbourhood where it may be placed.

Since this report was written, more specimens of iron from the boiler have been sent to the committee and tested by them.

The iron was crystalised in structure, with fibrous laminæ, and was evidently very brittle (cold short.)

Only two pieces were in such a condition as to allow of an experiment upon their strength. The first of these, cut with the grain of the iron, broke with a strain of 63,840 lbs. per square inch; the other piece cut across the grain, broke in the wedges with 48,720 lbs. per square inch.

It will be seen, therefore, that although brittle and improper to withstand a blow, the iron was much above the ordinary average of strength to resist a steady pressure.

By order of the Committee,

William Hamilton,

Philadelphia, June 8, 1848. *Actuary.*

Franklin Journal.

SPECIFICATIONS OF ENGLISH PATENTS ENROLLED BETWEEN THE 4TH AND 11TH OF NOVEMBER, 1848.

Felicite Raison Selligue, of Paris, Widow. *For certain improvements in propelling, and in the machinery employed therein.* (*Communicated by her late husband, Alexander Francois Selligue.*) Patent dated May 4, 1848; specification enrolled November 4, 1848.

The late M. Selligue was an engineer of considerable eminence in France. The invention which his widow has now patented, in compliance (we have heard) with a desire expressed by her husband, consists in obtaining an available mechanical power from the inflammation of hydrogen gas, mixed with the necessary quantity of atmospheric air, to render it explosive, and in the means or machinery suitable for applying the same to propelling or to motive purposes generally.

It is proposed to employ hydrogen gas, alone or in combination with other gases, to

render it cheaper; but any other explosive gas may be substituted, and used in precisely the same manner as hydrogen gas, although, generally, at a greater expense.

The machinery employed consists of two cylindrical chambers, composed of any malleable metal, and placed in the stern of the vessel, partially above the line of floatation, in which the gas is caused to explode, and which are narrowed towards their upper ends, and closed by cocks or taps. The chambers are bent almost at right angles, so that the top portions shall be nearly vertical and the lower portions horizontal to the keel of the vessel. The ends of the horizontal portions passing through the sides of the vessel, are open to the water, and are fitted with large circular collars, which lap over the sheathing of the hull, to which they are made fast by bolts and screws, so as to render the space between the wood-work and the chambers perfectly water-tight, and also to keep the latter firmly in their proper positions. They are further strengthened by the employment of suitable stays in the interior of the vessel. The openings to the water should be placed as far down beneath the line of floatation as possible, in order that the water which flows into them, after the gas has exploded, may do so at a speed greater than that of the vessel itself through the water, and so prevent any diminution of the effect resulting from the explôsion, that is to say, of the speed of the vessel.

In addition to the cock in the top of the contracted portion of each chamber, by which atmospheric air is admitted, there are two others on either side; by the first of these the hydrogen gas is pumped in from a gasometer, and by the second the hydrogen is caused, after its intermixture with atmospheric air, to ignite.

The mode of igniting the gas is as follows:—The barrel of the exploding cock is pierced with three holes, and its plug is fitted with a lever, by which it is opened or shut. To the lever is fixed an arm, which carries at the other end a small cup, which, at each closing of the tap, dips into a reservoir, containing alcohol or other easily inflammable liquid, and takes up a portion thereof. At the opening of the tap the cup is brought back into its original position, and empties itself through a funnel on to a sponge, the flame of which is thus maintained. The sponge is composed of a network of platina wire, filled with amianthus, and is fixed to the interior sides of the hole of the barrel of the tap, in such manner as not to prevent the free access of a current of air to the flame. Or, in place of the sponge, there may be employed a gas burner or jet, placed in the interior of the plug, and supplied from a gasometer, or small alcoholic lamp, the wick of which terminates in the centre of the hole of the plug. Another gas burner or lamp, kept constantly lighted, is placed underneath the centre of the hole of the tap, the object of which is to relight, after each successive explosion, the interior gas jet, or the alcohol in the sponge, or the wick of the alcoholic lamp. Or, again, instead of any of the preceding methods, the gas of the interior jet may be ignited by means of a voltaic pile or other electric machine; and a slide-valve may be substituted for the cock. The taps by which the atmospheric air and hydrogen gas are admitted, communicate with pumps, which differ in no respect from the ordinary force or lifting pumps, and should, of course, be closed at the moment of explosion. The inflow and outflow of the gases is regulated by slides, to which two motions are communicated—one to and fro, in a horizontal right line, and the other vertical, which is effected by shifting, at the end of the horizontal movement, the gear of the guide pinion. A small steam engine may be employed to work the pumps, and to give motion to the different parts of the apparatus.

From what has been stated, it will be seen that the operations to be performed are, Firstly, to exhaust the gases in the chambers after the explosions have taken place; secondly, to inject atmospheric air and hydrogen gas; thirdly, to turn the tap so as to shut off communication with the lamp or gas burner, and by the same movement, to bring the small gas jet in the interior of the plug into contact with the explosive mixture in the chamber; fourthly, to open the exploding tap as the explosions take place, and so on for each successive operation. The explosions are to be effected in each chamber alternately; and it is supposed that they will take place as regularly as the ascent or descent of the piston of a steam-engine. When they are opposite to each other, and the slide travels to and fro, one of these pumps exhausts one chamber while the other injects the other. The number of the chambers, their diameter, length, form, and place in the vessel, may be varied according to circumstances, and in some cases it is proposed to place two additional ones in the bows to drive the vessel astern.

The hydrogen gas may be obtained by the cold process of evolving it from iron or zinc steeped in a suitable acid diluted with water, or by the hot process, namely, from the decomposition of water by incandescent

coal. The last method is considered to be the most economical.

A modification of this arrangement consists in interposing a piston between the gas and water in the chamber, which is composed of a number of metal plates so hinged together as to assume a horizontal position and afford free ingress to the water after the gas has exploded, and vertical when the pressure on both sides has become equalised by the effect of their own gravity. The piston is brought to its original position from the extremity of the chamber after each explosion by means of a weighted chain attached to its inside surface.

The mode of applying the motive power thus obtained to hydraulic purposes consists in the employment of a metal chamber, somewhat like an inverted syphon in shape, which is closed at one end, and furnished with the same apparatus for injecting the atmospheric air and hydrogen, and then igniting the mixture as before described. It is placed in a water tank, and has a valve in the bend through which the water enters from the tank after each explosion. The explosion has the effect of driving the water down one leg and up through the other, in which are a series of valves, to a very considerable weight; or it may be shot up into a reservoir, whence it may be allowed to fall in a stream upon the float boards of a series of water-wheels.

In order to prevent the too rapid condensation in the chambers, the temperature (resulting from the explosion of the gas) is kept up for a longer period of time than would otherwise be possible by superposing a layer of some substance, the specific gravity of which is less than that of water, and its boiling point higher.

The patentee claims "the propelling, or moving bodies, or machines, by the power resulting from the explosion of a due admixture of hydrogen gas, or other inflammable gas with atmospheric air, such power being generated, regulated, and applied in the manner and by the means before exemplified and described."

HENRY WILLIAM SCHWARTZ, GREAT ST. HELENS, LONDON, MERCHANT. *For Improvements in Steam Engines.* (*Being a Communication.*) Patent dated May 4, 1848; specification enrolled November 4, 1848.

In this engine there are two cylinders superposed one upon the other. The top one, which is the smallest, communicates with the under one by ordinary means. The steam is admitted above and below the piston of the smaller cylinder, which is consequently driven downwards, and the communication between the two cylinders being in the meantime opened, the steam beneath is consequently driven into the larger cylinder, and its piston thereby forced down, and the air beneath expelled. The communication between the two cylinders is then shut off, and the steam above the piston of the lower one condensed or allowed to escape, that is, a vacuum is created and the atmospheric air admitted beneath its under surface, the unbalanced pressure whereof forces the piston upwards. This piston is without a rod, but communicates its upward motion by pressing against the ends of the two connecting rods which are furnished with springs to regulate the motion.*

The patentee claims "steam-engines constructed on the principle herein described, wherein the motive power obtained from steam and air is made to act upon loose pistons, or pistons not immediately connected with connecting-rods."

ALEXANDER SOUTHWOOD STOCKER, YORK-PLACE, CITY-ROAD. *Certain improvements in time-teachers and boxes, show-cards, or holders for matches, pens, pins, needles, and other articles, and in the mode of manufacturing the same.* Patent dated May 4, 1848; specification enrolled November 4, 1848.

The improvements in time-teachers (for instructing children to read the time off the dials of time markers) consists in stamping or punching them out of thin sheets of suitable metal, with the necessary figures thereon, and riveting loosely in the centres, hands of steel which by their elasticity may retain their position.

The improvements in boxes consist in punching lids and bodies separately out of metal sheets, with grooves on their edges to correspond one with another. Or with tongues to form the hinges. Or out of one piece of sheet metal, with the piece connecting the lid to the body to serve as hinges.

The improvements in show-cards consist in stamping or punching them out of sheets of metal with projections or indentations, into which fit the joints or indentations of the articles to be exhibited, and thereby held without tacking or further fastenings.

The patentee claims "the improvements in time-teachers and show-cards, the modes of manufacturing them and the combination of boxes" before described.

LEWIS DUNBAR GORDON, OF ABINGDON-STREET, WESTMINSTER, CIVIL EN-

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* We presume that the piston of the top cylinder is immediately connected with the connecting-rods, by the descent whereof they are brought into contact with the top surface of the piston of the under cylinder in a fit position for having its upward motion communicated to them.

GINEER. *For an improvement or improvements in railways.* Patent (for England,) May 9, 1848; specification enrolled November 9, 1848.

We gave the details of this invention two weeks ago from the specification of Mr. Gordon's Scotch patent (see *ante* p. 420), and need now only add the claims with which his English specification concludes.

"What I claim as my invention is,

"*First*, Forming the ends of rails in such a manner that the end of one shall rest upon the end of another in the manner described.

"*Second*, The manner of adapting thin plates of iron to form sleepers for supporting rails, as described, combined with the mode of fastening the chairs to malleable iron sleepers, also described.

"*Third*, The mode of supporting the ends of the rails by means of a girder, as described.

"*Fourth*, The arrangement for fastening the rails in the chairs above described.

"And, *fifth*, the mode of preparing the keys for railways in the manner described."

WILLIAM M'HARDY, SALFORD, MANAGER, and JOSEPH LEWIS, SALFORD, MACHINE MAKER. *For certain improvements in machinery or apparatus applicable to the preparation and spinning of cotton, wool, silk, flax, and other fibrous substances.* Patent dated May 9, 1848; specification enrolled November 9, 1848.

This invention has for its object, 1st. The more economical working of slubbing, roving, jack, and throstle frames by making the spindles thereof (which are supported in top bearings, and driven by warves or pinions below the copping-rail, in the usual way,) in two parts, to facilitate the doffing of the bobbin; and, 2nd. To obviate the necessity of having new spindles when the bearings thereof become worn, by placing hoops of steel or other suitable metal thereon, to form such bearings, and which can, consequently, be replaced by fresh ones when worn.

Claim. — "We claim the construction of spindles before described, whereby we are enabled to doff the bobbin from the spindles without removing the spindles from their bearings or disconnecting the driving gear, and particularly the making of the spindles in two portions, and attaching them together in such parts and in such manner by socket-joints, or other suitable means, as that the bobbin may traverse freely over the joint; and a reduction of a portion of the diameter of the spindles near the top, whereby they may be lifted up through the top bearing, and inclined at a sufficient angle to allow of the bobbin being doffed between the disconnected parts; and also placing hoops of steel, or other suitable material, on the spindles, to form the bearings thereof."

RICHARD LAMING, CLICHY LA GARONNE, FRANCE. *For an improvement or improvements in the manufacture of oxalic acid.* Patent dated May 9, 1848.

No Specification enrolled.

EDWARD HAIGH, WAKEFIELD, PLUMBER, AND MANAGER OF THE WAKEFIELD WATERWORKS COMPANY. *For an invention for measuring water or any other fluid.* Patent dated May 9, 1848; specification enrolled November 9, 1848.

This invention for measuring water or other liquids, consists of a wheel or drum, divided vertically by a partition, which contains on each side three measuring chambers. Above the drum is a "preparatory cistern" into which the liquid flows from two feed-pipes, and which is divided into four parts. The water flows from this cistern in two streams into one of the measuring chambers on either side of the partition alternately; so that while one chamber is filling, the liquid flows through the machine; but the gauge cocks and other parts of the machine being so nicely adjusted, and its being made to register twice as much as is actually measured, no error, it is stated, can occur. This drum is mounted on a horizontal spindle, and carries at one end a toothed wheel which gears into a toothed pinion, and communicates its revolving motion to an ordinary indicating apparatus as usual. On the periphery of the vertical partition are six projecting pins (equal to the number of measuring chambers) which catch against and rest upon the extremity of a tumbling lever, which is weighted at the other end by a ball, so that when the weight of the water in the measuring chamber exceeds that of the regulator, it gives way, allows the pin to fall, the chamber to turn, and the water consequently to flow out.

The patentee claims—"An apparatus or machine consisting of a preparatory cistern in connection with a drum or wheel containing two sets of measuring chambers, into which the water flows alternately from openings in the 'preparatory cistern,' and made to revolve by the liquid; and also the employment of the tumbling lever, or regulator, as before described."

Incrustation in Steam Boilers.—M. Cavé, the eminent French engineer, announces that he has ascertained that a number of small oak blocks thrown into steam boilers has the effect of completely preventing incrustations, and that it is sufficient to renew them about once a fortnight.

RECENT AMERICAN PATENTS.

(Selected from the *Franklin Journal.*)

IMPROVEMENT IN BRAKES FOR RAILWAY CARS. *John R. Grout.*

Claim.—" I claim, in the first place, the manner in which the momentum of the cars operates the brake of the tender by means of the fixture upon the first car and the rocking shaft, jointed slide-rod, and springs in the tender, the same being combined and operated substantially as described.

" Secondly, The particular manner in which the slide and lever in the car are arranged and operated as described; including in the said claim the manner in which the resistance of the tender operates the brake of the car, or cars in train, by means of the rod in the tender; and the slide lever, rods, springs, and rocking-shaft in the car, the whole being combined and operating substantially as before described.

"Thirdly, I claim the manner in which I combine and arrange the respective parts of the regulator; that is to say, I claim in combination the forked lever attached to the rocking shaft, the sliding tube which plays upon the shaft, to which the lower ends of the arms of the regulator are attached; the wheel to which the upper ends of the said arms are attached, which wheel, by its friction upon a friction plate or wheel, communicates the action of the arms of the regulator to the machinery beneath; by which arrangement, when the momentum of the train is suddenly diminished, the arms with their weights and the tube, may continue their motion, thereby preventing the rupturing of the apparatus, which would result from the attaching of the arms of the regulator to the shaft, as has heretofore been done.

" The mechanical arrangements all being the same, substantially as hereinbefore described, or varying therefrom only in form, which, it will be evident to every one conversant with mechanics, may be done without an invention or the introduction of any new principle."

IMPROVEMENT IN WATER WHEELS. *Uriah A. Boyden.*

The patentee says,—" The nature of my invention consists in causing the stream or streams of water from a water-wheel, to diverge gradually, or in causing the water which is ejected from a water-wheel, to be diffused gradually, whereby the momentum which the water has on leaving the water-wheel, is expended in diminishing the pressure of the water or air on the parts of the wheel which the water last leaves, which is effected by applying a diverging or flaring passage, or passages, the water necessarily passes through after leaving the wheel, which causes the stream, or streams of water to expand, or spread gradually, or to be gradually diffused; and hence I call this adjunct to the wheel, which I have invented, a *diffuser.*"

Claim.—" I claim the diffuser as described and as adapted and applied to all turbines, reacting, and all other water-wheels to which the same is applicable, viz., those which receive the water between their peripheries and axis, and discharge the water at their outer or circumferential parts, whether these parts be cylindrical, conical, convex, concave, or of whatever other form. I do not confine my claim to the precise forms of my diffuser described above, but I extend it to all forms which are essentially the same, in which the parts are so shaped as to form a gradually diverging, or spreading passage, or passages, or in which the passage, or passages spread, diverged, or enlarged from the wheel, by degrees, or by small steps, or offsets, so as to cause the stream, or streams of water on or after leaving the wheel, to expand, spread, or be diffused gradually, or by small steps, or degrees, so as to expand a considerable portion of the momentum which the water has on leaving the wheel, in diminishing the pressure of the water, or atmosphere, on the circumference of the wheel, or parts of the wheel, from which the water is ejected."

IMPROVEMENTS IN RAIL ROAD WHEELS. *Perry G. Gardiner.*

The patentee says,—" The nature of my invention consists in forming wheels of two corrugated, crimped, or convoluted discs of metal, having exterior convexities, united to a rim, or tire, by means of screw bolts drawing inwards their centres, and expanding the peripheries of the discs into grooves in the inner side of the rim."

Claim.—" What I claim as new, is the forming a wheel of two corrugated, crimped, or convoluted discs of metal with outward convexities, combined with a rim, or tire, by means of screw bolts, drawing inwards their centres, and expanding their pheripheries into grooves in the rim.

IMPROVEMENT IN SYPHONS. *Asahel Aldrich, Douglass.*

Claim.—" What I claim is the combining of the syphon with a closed receiver, in such manner as that said receiver shall constitute an enlargement of the syphon at the height to which the tower is to be raised; the lower and shorter legs of the syphon being so proportioned to each other, as that the latter shall be capable of receiving within it a column of air from the closed receiver equal in volume to that which has been drawn therefrom, for the purpose and in the manner described; whilst said longer leg

shall still contain a column of water more than sufficient to counterbalance the length of the column in the shorter leg; under which arrangement said column of air is discharged, and the closed receiver refilled preparatory to another intermission of the syphon for the discharge of water therefrom; and in combination therewith, the causing of the water which escapes from the closed receivers, operating by its gravity, to open and close the respective valves at the requisite periods for continuing the action of the apparatus; the whole arrangement and combination being the same in substance with that herein set forth."

IMPROVEMENT IN RAIL ROAD WHEELS. *Anson Atwood.*

Claim.—"I claim connecting the rim of the wheel cast in one piece with a solid hub, by the combination of a ring made of radial waves, in combination with the dished flanch, or flanches of the hub, which form a rim concentric with the rim of the wheel, substantially as described; whereby the several parts can yield to the unequal contraction in all directions without serious strain of the metal as described."

IMPROVEMENT IN HOT AIR FURNACES. *David Culver.*

The patentee says,—"The object of my invention is to obtain a large radiating surface, with the view to get the greatest amount of heat with a given amount of fuel, and so to arrange the parts that the inside may be kept clear of soot and ashes during the operation of the furnace; and the nature of my invention consists in making the drum, placed immediately over the fire, in the form of an hour-glass, surrounded with a series of pipes, the lower ends of which open into a chamber, formed by an inverted hollow fustrum of cone that forms the connection between the fire pot and the drum, and their upper ends opening into a dome that extends over them and the drum. And my invention consists, also, in a disc valve, or swinging partition in the smallest part of the drum, the valve being properly balanced and hung on journals, and provided with a weight attached vertically to its underside, to act like a pendulum, or provided with any other means by which to keep it closed, except when vibrated, to discharge the soot and ashes which may accumulate on its upper surface. By this arrangement of parts, the products of combustion in rising from the fire pot impinge on the curved surface of the drum, (which, as stated above, is formed like an hour glass, to present a large surface,) and against the valve, (which is kept closed by the pendulous weight,) and finding no escape they are deflected, and pass up the vertical pipes into the upper part of the drum, and dome, which they heat, depositing the soot and ashes on to the valve, or swinging partition, and then pass through a horizontal pipe into one division of a flat radiator down to the base thereof, and thence up the other division, and out into the exit pipe, the arrangement of this flat radiator, in combination with the circular radiator, constituting the third part of my invention. And the last part of my invention consists in uniting the horizontal and escape pipe with the top of the flat radiator, by means of a globe or sphere, in combination with a round disc valve, by means of which spherical enlargement and disc valve, the aperture for the passage of the products of combustion is always of the full capacity of the pipe."

Claim.—I claim making the drum which is placed over the fire-pot in the form of an hour glass, to present a large amount of surface to the action of the flame, and for radiation, as described, when this is combined with the vertical pipes surrounding the drum as described.

"I claim the employment of the disc valve, or swinging partition within a vertical drum, placed over the fire for the discharge of soot and ashes from the compartment above the swinging partition, as described.

"And finally, I claim the globe-formed enlargement at the junction of the pipes, and the flat radiator, in combination with the circular disc, valve, or damper, by means of which enlargement, in combination, the apertures for the passage of smoke, &c., are retained of their full capacity."

IMPROVEMENT IN SPARK EXTINGUISHERS. *Samuel Gibson.* "The operation of the machine is as follows: When the engine is set in motion, the steam, by acting on the fans at the bottom of the inner pipe, gives a rapid revolving motion to the shaft carrying the inner pipe, and then passing with the smoke, &c., into the spiral flue formed by the inner pipe, and spiral planes, keeps up and increases that motion issuing out of the top of the inner pipe, from whence the smoke and cinders are thrown with violence against the inside of the outer pipe, or its cap, and then falling down on the partition plate, are discharged by the oblique pipe downwards upon the road. When the apparatus is not in operation, the smoke is discharged by a pipe of the ordinary construction, made to open and close with a valve at the bottom of it, placed behind the triple pipe, or spark-catcher; the valve is managed by a crank and rod, passing to the hand of the engineer."

Claim.—"What I claim as my invention, is the combination of the triple pipe, and

the revolving screw, and in combination therewith, the oblique partition plate, and discharge pipe."

IMPROVEMENT IN CAR WHEELS. *Asa Whitney.*

The patentee says,—"The design of my improvement is to give a greater degree of elasticity, than has heretofore been given, to the wheels used on railroads, and to provide more perfectly for their ready expansion and contraction in virtue of such elasticity; and that whether said wheels are made entirely of cast iron, or of a combination of cast and wrought iron, or other metal, my improved wheels are of the kind in which the space between the rim, and the hub, or nave, consists of a disc, or discs, instead of the spokes that have been most generally employed. These discs I make corrugated in such manner as that a vertical section cutting them through their centres, and also a like division of them into circles at any point between their rims and naves, would present waved, curved, or sinuous lines, which may be either of continuous curves, or of straight lines and angles,—said wheels being corrugated in one or more forms, or in any form in which both the transverse and circular sections above named would produce such sinuous, or waved lines. I am aware that car wheels have been made with discs that were concavo-convex, both double and single, and that they have also been made with discs, the transverse section of which, from the rim to the hub, would present a waved line, consisting of two or more curves; but neither of these forms fulfil the condition of allowing a free expansion and contraction in all directions, resulting from the elasticity consequent on the manner of corrugating them."

Claim.—"I claim the corrugating of the discs of railroad wheels in such manner as that they are rendered elastic and flexible, and are susceptible of expansion and contraction, by the yielding of the corrugated parts, both in diameter and circumference simultaneously."

IMPROVEMENT IN CAST IRON WHEELS. *Asa Whitney.*

"The design of this improvement is to give a greater degree of strength, with a less amont of material, than has heretofore been given to the wheels used on railroads, which is accomplished by making the disc, or that part of the wheel between the rim, or hub, or nave, corrugated in radii from the centre, so that a vertical section around the centre, at any point between the rim and hub, will show a waving, or wrinkled line, which may be either in continuous curves, or in straight lines and angles, while a vertical section across the wheel through its centre, would present a straight line on the disc."

Claim.—"I claim the manner set forth of corrugating the discs of railroad wheels, by which they can be made stronger and more durable with a less amount of material, than any other form of disc, or spoke wheels, as heretofore made."

IMPROVEMENT IN STEAM-ENGINE VALVES. *James A. Stevens.*

"The object of this invention is to construct a less expensive and more perfect apparatus, for closing the steam valves at different portions of the stroke of the piston, and thereby cutting off the steam from the boiler, and allowing it to act expansively in the cylinder. This I mean to accomplish by what I call a drop slide; this drop slide elevates the valve to its required height with the original lifting rod, by means of its shoulder; and then the shoulder being withdrawn by an attachment to some suitable portion of the machinery, allows the valve to drop with any degree of velocity that may be found necessary on the curve of the drop slide."

Claim.—"I claim the method herein described, of connecting the lifter of the valve with, and disconnecting it from the lifter of the lifting rod, by means of the drop slide, in combination with the lifting rod and lifter attached to the valve, the drop slide being operated during the lifting of the valve, substantially as described; and I also claim the method of arresting the downward motion of the valve, by the inclined or curved face of the slide that holds and liberates the valve, whether it be the side herein ascribed, or any thing analogous, or equivalent thereto, as described."

WEEKLY LIST OF NEW ENGLISH PATENTS.

George Henry Bachhoffner, of the Royal Polytechnic Institution, London, Doctor of Philosophy, Professor of Natural Philosophy, for improved means of transmitting, communicating, or conveying intelligence. November 4; six months.

Joseph Cooper, of Walworth, tailor, for improvements in fastenings for wearing-apparel. November 4; six months.

Charles Iles, of Birmingham, machinist, for improvements in the manufacture of certain descriptions of dress-fastenings, and in the making up of dress-fastenings and other articles for sale. November 4; six months.

Henry Kempton, of Pentonville, Middlesex, gentleman, for improvements in reflectors and apparatus for artificial light. November 7; six months.

Moses Poole, of London, gentleman, for improvements in machinery for making nails. (Being a communication.) November 7; six months.

James Napier, of Swansea, operative chemist, for improvements in the manufacture of copper, and other metals and alloys of metals. November 9; six months.

Richard Coad, of Kennington, Surrey, chemist, for improvements in the construction of blast and other furnaces and fire-places. November 9; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Nov. 2	1648	William Reid	51, Conduit-street	Sans-pli shirt, without gathers.
,,	1649	Spilsbury, Butler, and Co.	Birmingham	Cooking, roasting, and baking apparatus.
3	1650	William Ramsay	Hull	Elastic seat for a saddle.
,,	1651	Thomas Edwards	Charing Cross	Military folding dressing-glass.
,,	1652	Thomas Edwards	Charing Cross	Camp and cabin shaving-glass.
4	1653	David Harvey	Admiralty and Somerset House,	Safety disconnecting plate for locomotive or any other railway carriage.
,,	1654	John Inderwick	Princes-street	Egyptian treble cylinder-pipe.
7	1655	William Tanner	Islington	Dial-plate for time-keepers.
,,	1656	Willis and Co.	St. James's-street	Australian mantle.
,,	1657	Christopher Hill	New Swindon, Wiltshire	Covering for wagons.
,,	1658	Robert Allason	Sunderland	Sifting-shovel.
,,	1659	Humphries and Thirst,	Chelsea	Flap-valve for sewers.
,,	1660	Thomas John Bingent..	York-street, St. James's	Spring clothes'-peg.
,,	1661	John Storrie	Clapham-road	Storrie's knife-board.
8	1662	Henry Moise	Holborn	File or holder for newspapers.
,,	1663	John Roberts	Eastcheap	Flower supporter.
,,	1664	George Caster Haseler,	Birmingham	Brooch-fastening.

NOTICES TO CORRESPONDENTS.

A stamped edition of the Mechanics' Magazine, to go by post, price 4d., is published every Friday, at 4 o'clock, p.m., precisely, and contains the Claims of all the Specifications Enrolled, New Patents sealed, and Articles of Utility registered during each week, up to the time of going to press. Subscriptions to be paid in advance. Per annum 17s. 4d., half-yearly 8s. 8d., quarterly 4s. 4d. Post-office Orders to be made payable at the Strand Office, to Joseph Clinton Robertson, of 166, Fleet-street.

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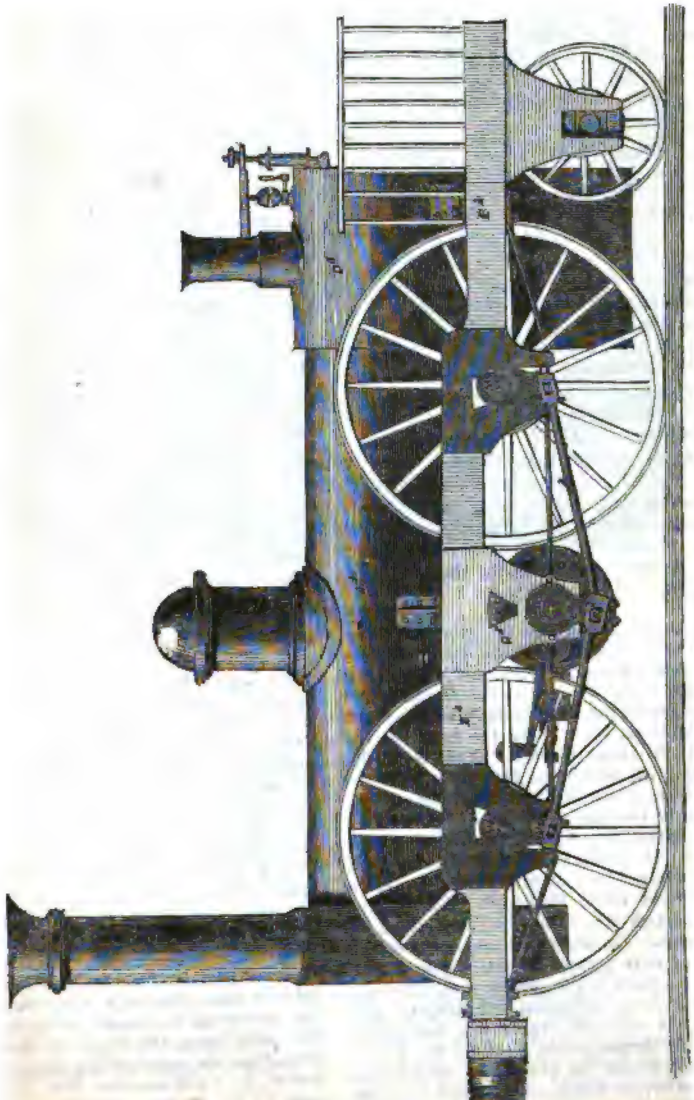
DAVIES'S PATENT LOCOMOTIVE.

Fig. 21.



DAVIES'S PATENT ROTARY ENGINE, STEAM-PROOF METALLIC PACKING, ETC.

(Continued from page 459.)

To give the necessary interpositions and pauses to the single sliding-stop employed in the single-acting engine, which formed the subject of Mr. Davies's former patent, he made use of two cams of a peculiar curve, which as they revolved came into contact with fixed curve pieces, or tappets, within the cam-box, and so produced the requisite to-and-fro movement of the stops; but it was found in practice that there was an objectionable degree of concussion attending the action of the cams on the fixed tappets. He now proposes, therefore, to substitute for the fixed tappets friction rollers, and to give such a curve to the cams that they shall act on and pass over the friction rollers with as little concussion as may be. In a double-acting engine, such as described in our preceding Numbers, the cams and friction rollers must necessarily come twice in contact in the course of each revolution; but it is required that one of the cams should be larger than the other. In the figures, C^a, represents the larger cam, and C^b the smaller. Y Y, are the boxes containing the cams. The curve to be given to these cams is separately represented on an enlarged scale in figs. 15 and 15^a, and the mode of striking it out is shown in the diagram, fig. 16.

Through the centre O^b, draw the line, $P^bO^bQ^b$. Set off on the line, $P^bO^bQ^b$, the two distances, O^bb^b, and O^bc^b. Let the distance, O^bc^b, be to the radius of the revolving piston, D, (see fig. 4) as the length of the lever, B′, is to be the length of the lever, G′ (same figure). And, similarly, let O^bb^b be to O^bc^b as the diameter of the revolving piston, D, is to the interior diameter of the fixed cylinder, B. Then from the centre, O^b, with the radius, O^bb^b, describe the circle, H^b, I^b, K^b, L^b, and with the radius, O^bc^b, describe from the same centre the circle F^b, E^b, c^b. The circles thus drawn will form the foundations of the cams. To determine the throw of the cams, I next proceed as follows, beginning with the throw of the smaller cam. Through O^b I draw the horizontal line, $B^bO^bC^b$, and from the point, E^b, where this line intersects the larger circle, I set off E^b, D^b, of a length proper for the radius of the friction roller, g', which length must be such that the cam shall in revolving turn clear of the boss of the friction roller. And from D^b, as a centre, and with a radius, D^bE^b, I strike the periphery of the roller, g'. From D^b towards E^b, I set off D^be^b equal to b^bc^b. I then describe a semicircle, D^b, 12, and e^b, on the line, e^bD^b, divide this semicircle into any number of equal parts, 1, 2, 3, &c. And from these points I let fall perpendiculars cutting e^bD^b in f^b, g^b, h^b, &c. From the centre, O^b, with radii O^b, e^b, O^b, f^b, O^b, g^b, &c., I describe the arcs, e^b, z^b, f^b, y^b, g^b, x^b, &c. Then upon the large circle, $F^bH^cc^b$, I set off an arc, E^bG^b, subtending one half of the angle, $G^bO^bN^b$, through which the axle will have turned during the time the stop remains entirely within the chamber, G^a. On the same circle I also set off the arc, G^bH^b, subtending an angle, $G^bO^bH^b$, which represents the time the axle takes in turning through an angle which will be equal to the time which the stop takes to cross the annular space after it has entered into the cylinder. I divide $G^b H^b$ into the same number of equal parts which the semicircle, D^b, 1, 2, e^b, &c., has previously been divided into, and from the centre, O^b, draw the radial lines, O^b, p^b, O^b, q^b, O^b, r^b, &c. Then from the points, p^b, q^b, r^b, &c., where the radial lines intersect the curves D^b, p^b, o_b, q^b, &c., and with a radius equal to the radius, $D^b E^b$, describe the arcs 1, 2, 3, &c. The contour line traced by these arcs will give the curve required. I proceed similarly to get the return curve, $E^bN^bM^b$. The projection of the cam on the opposite extremity of the diameter is obtained the same way. The throw for the larger cam is obtained as follows: From E^c on the line of. $B^bO^bC^b$, I set off $E^c D^c$ equal to D_bE_b, and with a radius, E^cD^c, draw the circle, B^bE^c. From D^c towards B^b, I set off D^ce^c equal to D_be_b. Upon D^ce^c I describe the arc, D^c, 1′, 2′, &c., e^c, divide it into any number of equal parts, and let fall perpendicular to the line, D^ce^c, intersecting D^ce^c in f^c, g^c, h^c, &c. From O^b, with a radius, O^b, e^c, O_b, e^c, O_b, f^c, &c. I describe the arcs, e^c, z^c, f^c, y^c, &c. From E^c, I set off an angle, E^cG^c, equal to the angle subtended by the arc E^bG^b, and G^cH^c equal to the angle, G^bH^b. I next divide G^cH^c into the same number of equal parts which the semicircle is divided into, and draw the radial lines, O^b, p^c, O^b, q^c, O^b, r^c, &c. Then from the points of intersection, p^c, q^c, and r^c, &c.; with a radius, D^cE^c, I describe arcs 1′, 2′, 34, &c., which will give the

curve required. The return curve, and the curve for the opposite throw, are obtained in precisely the same way. While revolving, the cams press alternately on the friction rollers, $g'g''$, that is, the small cam, C^b, presses upon the roller, g', and the larger cam, C^a, upon the roller, g'', twice in each revolution. This gives a to-and-fro movement to the cam-boxes, Y Y, which is communicated by the arm, A^a, to the lever, B′, keyed to the way-shaft, I. The way-shaft, I, gives motion to the lever, G′, which motion is communicated by the link, D′, to the cross-head of the rod, P, which is directly connected with the sliding-stop, F^a.

The sliding-stop in the box, G, oppo-

Fig. 16.

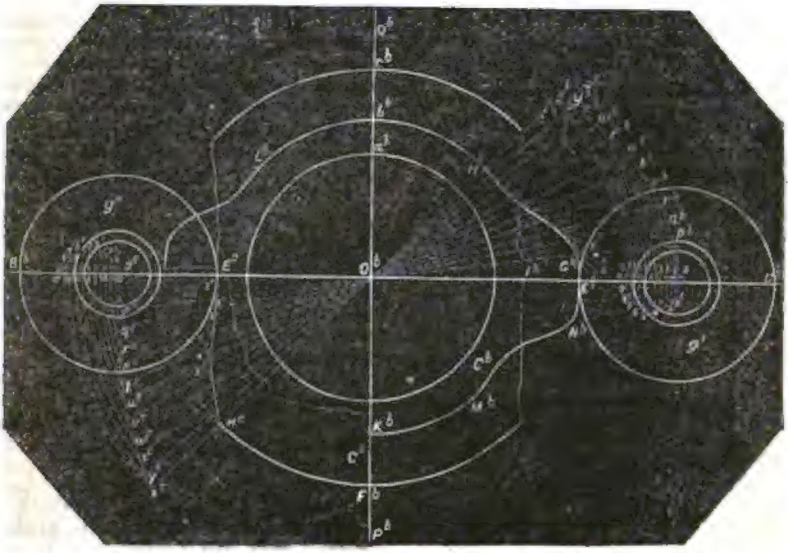
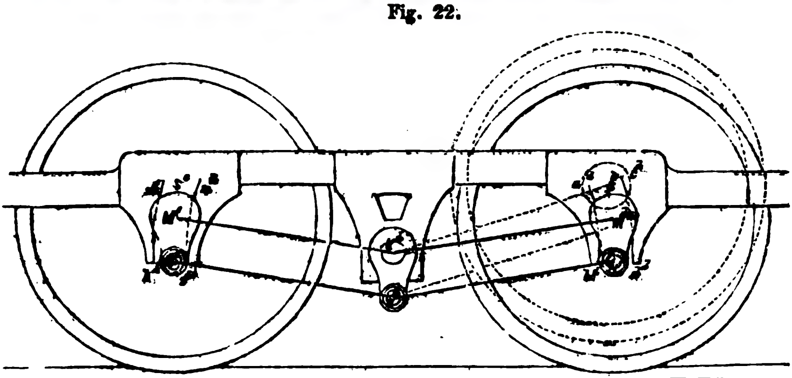


Fig. 22.



site to that just described, is worked by a similar arrangement of levers, motion being communicated to them by the lever, E′, through the connecting-rod, F′. (The course of motion is best seen in fig. 4.)

Mr. Davies proceeds next to show the modifications necessary to be made in the preceding arrangements when the engine is a single acting one, but these we pass over, as we do not imagine that, after the advantages which have been shown to attend the double action piston, there is much probability of any one

preferring a single-acting engine even for small horse powers.

We shall also pass over, for the present, a very excellent arrangement for giving a quick motion to the expansion valves, and proceed to the part of the specification in which Mr. Davies shows how his double-acting rotary engine may be applied to locomotive purposes.

Fig. 15.

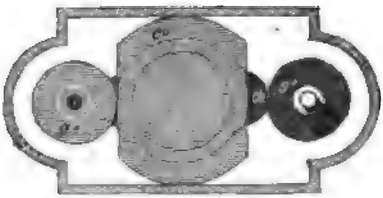


Fig. 15ª.

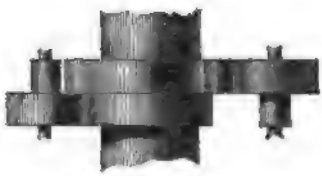


Fig. 21 is an elevation of a locomotive carriage, with rotary engine attached. A^d is the boiler; D^d, the fire-box; E^d, framing; F^d, engine, which is supported by checks, G^d, depending from the framing; K^d, main shaft of engine; L^d, crank of engine; M^d and M^e, coupled driving-wheel axles; N^d and N^c, cranks of the coupled driving-wheels; and O^d and O^c connecting-rods working from the crank-pin, R^d, of the engine to the cranks fixed to the driving-axle; S^dS^e are the gabs, within which the axles, M^dM^e, of the driving-wheels, rest; but these gabs are not made parallel and perpendicular, as usual, but of the curved form shown in fig. 22, in order to prevent, under all circumstances, any undue strain upon the rods, O^d and O^e. The curve given to them is composed of small segments of circles struck from the centre, K^d, as represented in the diagram, figure 22. K^d is the main axle of the engine; M^dM^e, the axles of the wheels. From the centre, K^d, with the radius, K^dm^d and K^dm^e, I describe the arcs, a^d, b^d, c^d, d^d, m^d, f^d, m^e, h^d, which represent the interior surfaces of the gabs, S^d, S^c. The crank, M^dN^d, is equal to the crank, M^eN^c, and also to the crank, K^dR^d. The connecting-rods are equal to each other, and to the radius, K^dM^d. Therefore, drawing the line, K^dM^d, a parallelogram, M^d N^d, K^d R^d, is formed. And the like will be the case in whatever position of the gabs the centre of the axle, M^d, may be placed. For suppose the wheel encounters an impediment on the rail which causes the axle, M^d, to rise in the gab till it assumes the position indicated by the dotted circle; then, as the axle slides in the periphery of a circle whose centre is K^d, the parallelism of the action is maintained, and no undue strain or irregular action can possibly affect the connecting rods.

The curve given to the gab in this engine is particularly deserving of attention, because it may evidently be adopted as well in reciprocating as in rotary engines, and with great advantage in both.

Mr. Davies describes another adaptation of his double-acting engine to locomotive purposes, in which the power is transmitted to the wheels through the medium of wheel-gearing.

The mode of working the expansion valves, to which we have before adverted, we shall give along with some remaining explanatory details in our next.

A LIQUID FOR CLEANING METALS.

One of the first operations in finishing metallic work after it comes from the casting, or from the hammer, is to free it from the coat of oxide which adheres to it: this is done generally by keeping it for some time in water, strongly acidulated with sulphuric or muriatic acid. But an inconvenience in this process arises from the fact that the metal is liable to be attacked on its lines and angles, and wherever it presents a point or edge. Hence arises a double loss, both of the acid employed and of the metal.

MM. Thomas and Dellisse state that they have succeeded in avoiding these inconveniences, by combining with the acid of the bath certain organic matters which have the property of preventing, or at least of considerably diminishing, the influence on the metal of the acids. According to them, glycerine, artificial tannin, naphthaline, and creosote, attain this end. In the baths thus composed, the scale of oxide detaches itself without dissolving, and without the metal being attacked, so that the pieces may remain in the bath, as long as may be desired without alteration.

These facts announced by MM. Thomas and Dellisse are corroborated by the experiments of M. Flachat, chief engineer of the

Versailles and St. Germain Railroad. M. Mertian, proprietor and director of the forges of Montataire, and M. S. Falatieu, forge-master at Bains, testify that they have tried this process upon sheet iron, and have adopted it to the exclusion of all others. The economy of this process, compared with the former ones, is about two-thirds of the acid employed, and 50 per cent. of the loss of metal in cleaning.—*Bull. Soc. Enc. Indus. Nat., January*, 1848, p. 51.

THE REFORMS AT CAMBRIDGE.

"With curious reverence we keep up, and transmit from generation to generation, the superstition of what we call the education of a gentleman."—THACKERAY.

His Royal Highness, the Chancellor of the University of Cambridge, must have read with some degree of conscious embarrassment the compliments paid to him by the *Times* for his supposed predominant share in the late reform in this establishment.

That Prince Albert's approbation of the proposed "Graces" was obtained, as a *mere matter of form*, may or may not have been true; just as in former times, the certificate of a candidate for admission into the Royal Society must have travelled to Kensington Palace before it was "suspended in the meeting-room." But beyond this, there is reason to believe that the Prince had not the slightest part in the matter. The fact is, that the changes embodied in these Graces were in contemplation long before H.R.H. was elected Chancellor; and the object of their promotion was very different from that which the *Times* assumes. *The real object was to further "by a side-wind" the antipathy of Mr. Hildyard and his class, to the private-tutor system.* That the professorial system had long been effete everybody knows: but the bishops, by *requiring that a certificate* should be produced by every candidate for holy orders, from the Divinity-Professor, that the said candidate *had submitted himself to a "voluntary examination"* in theology, produced a formal resuscitation of the importance of the lectures on divinity.

The success of the bishops in "enforcing the voluntary examination," led the Caput to the belief, that means might be devised for filling the other professorial lecture-rooms with auditors, and the professorial pockets with fees. The simple institution of professorships was a device, and a happy one, of by-gone days, to meet the wants of the state of mental society as it *then* existed. Teachers of ability were then few, and good books from which to pursue a study in the closet still more rare. The teachers were then obliged to take *large classes;* and instead of giving those special instructions which one or two students might require, they were obliged to generalise their instructions so as to include only general principles, and, of consequence, to pass over all special difficulties which individual minds might encounter. To speak in reference to the present practice, they were obliged to merge the lesson in the lecture, and the tutor in the professor. It should be remembered, however, that in the period when professorships were instituted (for the sciences especially) in our Universities, the several faculties included but a very limited range of special topics. Mathematics was composed of geometry only, and this almost wholly confined to the Elements of Euclid with a few obvious and perhaps *practical* deductions — the "cabalistic art" of algebra being deemed more nearly akin to the service of the "gentleman in the black domino," than to the service of Him to whom that dominant party in the church, which regulated the Universities, owed its allegiance. The highest aim of the worthy Archdeacon to whom the Plumian Professorship owes its endowment, was to imitate Gresham College, and its favourite scion, the Royal Society of those days, in making and exhibiting experiments and cultivating what was then called "natural knowledge." Even coming down to recent times, the Jacksonian Professorship was instituted for only a very limited purpose; and instituted, too, in a place where it was about as likely to be useful as if it had been located in Caffreland—filled though the office now is by one of the most able and original men of whom England can boast. Transfer this chair to Leeds, Manchester, or Birmingham, and Professor Willis would obtain a crowded, and interested, and inquiring auditory; but at Cambridge it is a boon thrown away—it is not wanted there, for the knowledge to be gained from it "will not tell in the Senate-house." The same, or nearly the same, too, may be said of all the professorships in the Universities; they are not

adapted to the time, the place, and the students. In truth, the most recent of all the Cambridge institutions, its Observatory, is the only one which has not fallen into desuetude; and it would almost seem, as though by a perversity for which it is difficult to account, that this too is doomed in its turn to follow its academic antecedents. Of this, however, we may have more to say hereafter.

The landed classes in earlier days, with the exception of a few rich citizens, were the monied classes:—the only ones who could afford to send their sons to the Universities. Even of these "youngsters," but few were sent, except the second or third son who was to inherit the "family living." Till less than two centuries ago, the Universities were mainly roads into the Church; and these corporations then existed almost exclusively for ecclesiastical purposes. They have gradually become in practice more expanded, though their constitution is still essentially ecclesiastical *in its form*. They form now the great highways to the bar and the senate; and byways too (somewhat obscure, no doubt, but very select) to the practice of physic. These things have given a new social importance to the Universities—so much so, that it has, by degrees, led to the popular opinion that a man of university education is your only "true gentleman-scholar." The forms of university existence are hence ecclesiastical, whilst its effective instructions are more than half of a civil character.

The only utility of the Professor's labours can arise from his guiding and directing the studies of the great number of men who repair to the Universities. It is his proper business to *lead the college-tutors* into the best modes of teaching the most important subjects; and in this employment, the professorships would be of great value, if properly worked for the purpose. Instead of this, however, each college tutor takes that duty upon himself (in his own college, if a small one, or his own "side," if either of the large colleges;) and the consequence is, that the instruction being given by way of lecture, and, consequently, in mathematics at least, the student being unable to follow the lecturer's brief and often confused enunciation of his truths and proofs, is obliged to have recourse to private assistance. Hence has arisen the large and influential body of private tutors—that body by whom the *effective education* of the University is really carried on, and without whose aid, the entire university system must sink into greater contempt, than we would volunteer to describe.

That the private-tutor system has been much abused is notorious enough; but it cannot be said of these men (many of them the ablest and most accomplished resident members of the University, notwithstanding their having committed the unpardonable sin of matrimony, and disqualified themselves thereby for being college tutors,) that they receive, like the professors, their fees for *unrendered services*. That they have "coached" many a man through for the common degree, whom it would have been for the interests of society and of learning, as well as the real credit of the University, to have "plucked," is only too well known; and that many a man has been placed high in the honour-list, by means of the "tricks of analysis" (as we heard a high wrangler express it a day or two ago) with which a dexterous private tutor has prepared his pupil, is equally certain. But were this system of private tuition suppressed, Cambridge would in three years possess a mere decimal unit of its present academic population; in fact, the college tutors would be changed into private tutors, and even then not be overworked.

Every master of arts (and the bachelor, we believe, partly, but of this we are not certain,) is, in virtue of his degree, a professor of the faculty in which he has graduated. The Caput cannot deprive him of this privilege; but one ultimate effect of the late Graces must be, to extinguish this privilege of the masters of arts to teach within the limits of the University. Who can tell how much this consideration may have worked with the "placets" on the recent occasion? Who, indeed, can doubt that it did exercise a large—if not casting—influence on the minds of the voters? These Graces are not the only indication, or the only result of the hostility of the monks to the benedicts. It would have been more manly on the part of the Caput to have brought in some Grace or Graces for regulating, or, what would have been better, uniting in a friendly bond, all the resident members of the University, so as to preclude the abuses and retain the

valuable services of the private tutors. All who wish well to the University, cannot fail to regret these tortuous windings of little policy, and to wish that the real objects of these Graces had been publicly declared, as privately they are not denied.

That their effect will be beneficial there are many who doubt, and many who are hopeful. It is remarkable, at any rate, that more than a moiety of the resident masters of arts (it is calculated at two-thirds) non-placeted these Graces; and that their being carried was owing to the non-resident members of the senate:—men who had been out in the world, and had learned in another school than that of *alma mater*, what the present state of society imperatively demanded in the way of education. The movement is looked upon by the public as a *popular* one and as a *liberal* one. Under this aspect, the *Times* may be right, "that it has taken the public by surprise."

Taking these Graces, however, in their best aspect, and entirely omitting the question of their *intention*, they are like the Graces of May, 1846 (see *ante*, vol. xliv., p. 411,) only so many *steps* towards university reform. They are analogous to our national Reform Bill—not so much of value for their absolute ("finality") perfection as for what they may, and perhaps will, *entrain*. If, on the other hand, they be not followed up by general enactments of the academic parliament, or guarded by by-laws of the academic executive, they may be made engines of gross wrong to individuals. The question has now become a national one, and the working of the law will become an object of national interest; and any vagaries in which the Caput may indulge itself will become subjects of public comment in a shape to secure at least some amount of justice to individuals. We, however, anticipate, on the whole, some good from these Graces, though our anticipations be not unmingled with much of anxiety. For good or for evil, the change is a great one, and pregnant with consequences which, perhaps, few of us can foresee.

Cambridge has extended her system of recognised and rewardable academic studies: what will Oxford do? The latter has been hitherto considered the University of the patrician, the landlord, and the golden *parvenu*. In the present instance, Cambridge nobly takes the lead: let Oxford follow, and not only recover her place, but as nobly retain it. If the patrician race are prepared for maintaining the foremost ground, "now's the time or never." Our monkish and our corporate institutions must give way to the enlightened masses, or be swamped in the new times and circumstances that are developing themselves around us. When the "pious king" under whose "benign reign" we ourselves were born, decreed that every child in his dominions should learn to read his Bible, he gave an impetus to social improvement which he little anticipated. Opposed by the clergy and opposed by the aristocracy, his majesty, with characteristic pertinacity, insisted that so it should be; and though the success of the royal scheme has not been as complete as could be desired, yet the difference between the present state of English society and the English society of our boyhood, is more like the fantasies of a dream than the realities of actual life. The boy who had learnt to read his Bible (the most difficult book in our language,) would, of course, be able to read all others; and he would seek for such knowledge of a secular and scientific kind, as should raise him above the ignoble station to which he was born. We now see the children of men who, when we were young, could hardly designate a single letter by its name, not only amongst the "readers," but amongst the "philosophers" and the "literati" of our land. Let the man of sixty (aye, even of fifty) summers look back, and consider what half a century has wrought. Let him, too, who has known no other mode of existence than that which the academic life of those days implies, compare the men of his young memory with men of the present day, and he will discover a portentous change. These are not the times for trifling with *great principles;* for the onward progress of the human mind, when once set in motion, is not to be arrested by dull platitudes, by inertia, or by opposition. The tocsin is sounded—let the "privileged" beware! Their only privilege *now* is, to take the lead in great and good deeds—in the cultivation of letters, and the promotion of science—in the exercise of philanthropy, and the diffusion of holy truth. But have they the

energy to do this? Their last opportunity is staked; and even this is deeply mortgaged for their past shortcomings.

Three-fourths of the active men of the University of Cambridge spring from the class that the vapid conceit of Oxford calls "*low*;" and this in no small degree accounts for the recent changes. The Cambridge men are *of* the people, and (though a few may forget their origin in their days of exaltation) they are much more frequently *with* the people, than *caste* men of Oxford hitherto have been. Changes, therefore, adapted to the wants of the people were more likely to emanate from Cambridge. Ours is called (truly or not we will not inquire,) "a popular Government"; and Cambridge has the honour of introducing into the "people's University" (as we trust Cambridge will *deserve* to be called,) the means of instruction in all those subjects and duties that are essential to the well-being of a free and enlightened people.

It cannot be questioned for a moment, however diversified be the hypotheses framed to account for it, that the number of minds capable of investigating the phenomena of natural history and of social life, is much greater than the number competent to deal with the purely contemplative classes of research—whether mathematical, metaphysical or literary. The *orthodox* studies of Cambridge are only fitted for few minds; and indeed for very few, if the philosophy of mathematics as well as its mere mechanism, be proposed as the subjects of study. Many a man, who has not cared a single straw for mathematics, in the shape of attachment to the science itself, has yet worked like a mule-in-a-mill, to get up a certain portion of "book-work" for the Senate-house Examinations. This almost intolerable labour has been gone through—simply with a view to obtaining a place on the tripos that should be valuable to him in after-life; and this once obtained, the successful candidate for honours, never to the end of his life opens a mathematical book, except he become a college or private tutor, a schoolmaster, or an actuary. Half the reading men are killed, or have the seeds of death implanted in their constitutions, during their undergraduate career—and for what? The doubtful honour of a certain status on the B.A. list of the year! Most certainly there is no essential implication of *high general ability* in a man's standing high on the honour list of mathematics; and we have all met with such men who have sunk into the most mindless drones alive—their physical and intellectual energies alike destroyed by the "forcing system" which has been in the course of development during the whole of the present century.

Till very recently the great majority of the men contented themselves with obtaining the common degree. The road, it must be confessed, was easy enough, and the gate sufficiently wide, for all to enter who "crammed up" during the last term. Even at present, with the aid of the Graces of 1846, the examiners are forbidden to propose any thing in geometry that implies more of Euclid than the first six propositions of the Sixth Book! in common algebra which implies equations!! and in physical science that could not be answered by any girl of sixteen in a well-conducted ladies' school!!! The classical, theological and moral acquirements are (of course, in Cambridge) on a still lower scale. In fact, as Dean Jackson said of Christchurch-men:—a majority of them bring away less learning from the University than they took there.

There was the eternal apology for these men, that they had "no genius for mathematics," and that nothing else was read in the University—especially, that nothing else would "tell in the examination for degrees." The actual demands upon the men are those which would better befit a class of boys eight or nine years the juniors of these men; and are certainly not of too high a character, to enable a gentleman to make a decent appearance in intellectual society. The mind of that man, indeed, whose whole stock of learning is comprised in this, must learn even this very imperfectly, and possess an intellect altogether undisciplined. Degrees at best are but invidious distinctions—won, where won with honours, by a single effort rather than by sustained exertion—and, when obtained, fail to give any other satisfaction than that arising from their vain parade and their commercial worth.

The great point gained by the new laws is this:—that men who have "no genius for mathematics," will now have an

opportunity of distinguishing themselves in any one of the sciences included under the general terms of Graces B and C. There will no longer be any room for the old plea of the unsuitableness of the studies to the general character of the men who repair to Cambridge for a degree:—it always being assumed that every man who enters the University, has the least "genius" (or even talent) for any science or literature whatever. This will hereafter form a criterion of the ability displayed during University residence; and *lower the importance of the common degree to its proper value in public estimation.* There will only be required two things more to render this perfect. First, *the publication of the marks given for a complete answer to each question, with the marks gained by each man;* and, secondly, *a distinction in the initials which are allowed to be used by those who have gained honours from those allowed to the candidates who have not.*

One thing is certain, that a much smaller number of men will "go in" for mathematical honours than has recently been the case. In fact, there has lately grown up a practice of entering for mathematical honours,—the men trusting either to get amongst the "junior ops." or get their "degrees allowed;" in order to avoid the classical and moral examinations for the common degree! This will of course cease in the mathematical tripos: but will it not be liable to take deeper root on the "natural history" and "moral science" triposes? Without great vigilance on the part of the examiners this will certainly take place; and we know that some of the men whose experience in the working of the university system entitles their opinions to great weight, do not consider that the machinery provided by the Graces is capable of working out the new system without the introduction of abuses so great, as to neutralise the benefits which these enactments might be expected to confer. It rests now with the heads, the fellow-tutors—aye, and the private tutors too—to devise such means as shall form a complete barrier to the "speculation in degrees" becoming otherwise than honestly successful according to the generally-understood "intent and meaning" of the Graces of October 31, 1848.

NEW METHOD OF EXTRACTING PURE GOLD FROM ALLOYS AND FROM ORES.

The following method of obtaining pure metallic gold in the form of a spongy mass has been practised by me for several years, and no account of the process has, to my knowledge, heretofore been published. It is very useful to the chemist and to the manufacturer, and is more economical than any other method that I am acquainted with.

After separating the gold from silver by means of a mixture of nitric and hydrochloric acids, as is usually done, the solution containing gold and copper is to be evaporated to small bulk, and the excess of nitric acid is thus driven off.

A little oxalic acid is added, and then a solution of carbonate of potash, sufficient to take up nearly all the gold in the state of aurite of potash, is gradually added. A large quantity of crystallized oxalic acid is now added, so as to be in great excess, and the whole is to be quickly boiled. All the gold is immediately precipitated in the form of a beautiful yellow sponge, which is absolutely pure metallic gold. All the copper is taken up by the excess of oxalic acid, and may be washed out.

Boil the sponge in pure water so long as any trace of acidity remains, and the gold is then to be removed from the capsule and dried on filtering paper. It may be formed into rolls, bars, or thin sheets, by pressing it moderately in paper. I have made several useful applications of the gold sponge thus prepared, and had a tooth plugged with it in October, 1846, to which purpose it is well adapted.

By moderate pressure the spongy gold becomes a solid mass, and burnishes quite brilliantly.

The jeweller or goldsmith will find spongy gold to be quite convenient when he requires it for a solder, and it is a convenient form of the metal for making an amalgam for fine gilding. I have used it for some years in soldering platina, and prefer it to the filings or gold foil for that purpose. His method of separating fine gold from coarse is very simple, and cheaper than the usual process. It is applicable in the separation of gold from ores that may be treated by acids, and is vastly preferable to the method commonly used by chemists and assayers.

When making oxide of gold for dentists' use the chemist will find that oxalic acid added to his potassic solution will at once recover all the gold that is dissolved in an excess of the alkaline solution. Many other applications of this very simple method will occur to chemists and artisans.—*C. T. Jackson, Silliman's Journal*, September, 1848.

GUTTA PERCHA PATENTS.—NO. XIII.*

CHARLES HANCOCK, of Brompton, gentleman. For "certain improved preparations and compounds of gutta percha, and certain improvements in the manufacture of articles and fabrics composed of gutta percha alone and in combination with other substances." Patent dated May 11, 1848; Specification enrolled Nov. 11, 1848.

Specification.

1. In making waterproof shoes and goloshes of gutta percha, I begin with casting the gutta percha in moulds into pieces or blocks, of a form suitable for the purpose. Fig. 1 and fig. 2 are plans of two of these moulds, with the top parts removed; and fig. 1ᵃ and fig. 2ᵃ, transverse sections of the same respectively, with the top parts on. By the former (figs. 1 and 1ᵃ) the gutta percha is cast in perfectly flat pieces, but thicker in the centre part, *a*, of which the sole is to consist, than at the sides and ends, *bb*, or parts of which the upper is to be formed. By the latter (figs. 2 and 2ᵃ) the piece is curved at the sides and ends, and so brought partially into the form which it is intended it should ultimately assume. A and B are in each case the bottom and top parts of the mould, and C the gutta percha. The size and curvature of these moulds admit obviously of any needful variation, so that there may be blanks produced (for example) suitable for the shoes and goloshes of persons of all ages, for left feet and right feet, &c. &c. I next take a last of the form desired to be given to the shoe or golosh, and draw upon, or otherwise fit closely to it, some elastic or flexible material, which may serve as a lining for the gutta percha, such as cotton or woollen cloth, or knitted silk or worsted, or cotton. I then coat the outside of this intended lining with a solution of gutta percha or caoutchouc, and leave it to dry. I next select a gutta percha blank, of the form best adapted in its general outline to the said last, and, by heating it in any convenient way, bring it to such a plastic state that it may be readily moulded by hand. I warm also the last, with its elastic or flexible covering, but not to such a degree as to decompose the gutta percha or caoutchouc solution spread over it; and these preparations having been made, I place the last upon the blank, adjust by hand the one to the other, and press the gutta percha of which the blank consists into as close combination as may be with the elastic or flexible covering of the last. The shoe or golosh then takes the determinate form represented in fig. 3. But as, in the course of the preceding manipulations, some inequalities of surface may have been unavoidably produced, or the limits between the sole and the upper not have been sufficiently defined, I once more bring the whole into a warm or plastic state, by dipping the shoe or golosh (with the last still inside of it) into hot water, or by exposing it to steam or hot air, and then smooth it carefully all over. When it becomes cold and hard, I run a revolving stile or other suitable instrument over the contour lines, after which the last is withdrawn, which leaves the shoe or golosh complete. Sometimes I use hollow lasts, made of metal, glass, or earthenware, and heated by steam, hot air, or hot water.

When made in the manner just described, the article, though water-tight, is of a dull appearance; but it may have a high polish given to it, or to any part of it, by applying glass or porcelain moulds to it after it has undergone the process last hereinbefore mentioned, and while it is yet in a warm and impressible state; each of these moulds being a *fac simile* in reverse of some portion only of the last (as, for example, the sole or upper,) and not removed after being so applied till the materials beneath have become quite cold.

Shoes and goloshes made of gutta percha, on foundations of elastic or flexible materials, in the manner before described, possess this great advantage over others, that the foundations take up and disperse the perspiration of the foot, and prevent it from condensing, to the injury of the health and comfort of the wearer.

Exception has been taken to gutta percha shoes and goloshes on account of their want of or deficiency in springiness. I remedy this (when desired) by making the blank out of which the sole and upper is formed, of two sheets or pieces of gutta percha, and interposing between them, while they are yet in a warm or plastic state, a thin plate of steel, slightly bent in the direction from heel to tip, and press the whole closely together, so that the metallic spring may become permanently fixed, embodied in, and combined with the other materials.

2. In employing gutta percha as a substitute (in whole or in part) for the wood and other materials of which the backs and stocks of brushes are ordinarily formed, I proceed according to the improved methods following.

Supposing the brush is to have a flat back, I take two, three, or more pieces of sheet gutta percha, or of a compound of gutta percha and caoutchouc (the number of pieces depending on their thickness, and on the thickness also to be given to the back,) which have been cut or stamped out, or cast into a proper form for the back, and superimpose them exactly one upon the other. I

* For the former patents, see *Mech. Mag.*, Nos. 1180, 1181, 1182, 1183, 1186, 1200, 1232, 1233, 1258, 1286, 1291, 1293.

then bore holes in them, through which I draw the parcels, or "knots," as they are technically termed, of hairs or bristles in the usual way, securing them also, as usual, by means of wires. I next give the top surface of the back two or three coats of gutta percha solution, leaving each coat to dry before another is put on. And finally, I lay on a solid piece or slab of gutta percha of a suitable thickness, and bring the same,

Fig. 1.

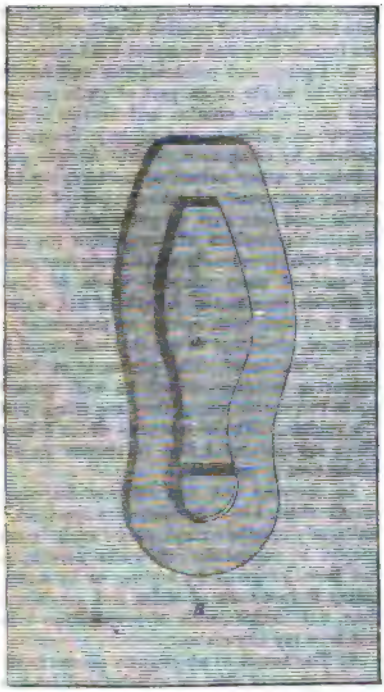


Fig. 2.

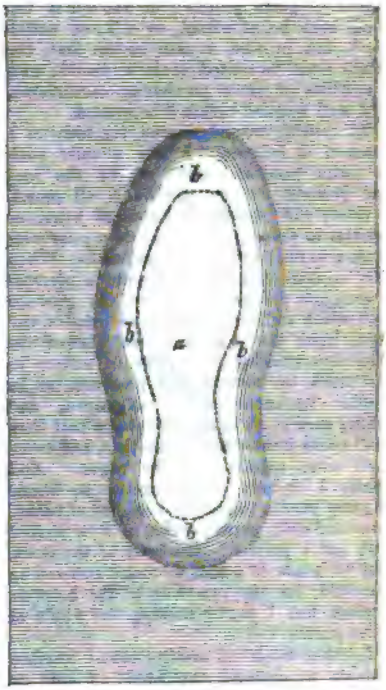


Fig. 1ᵃ.

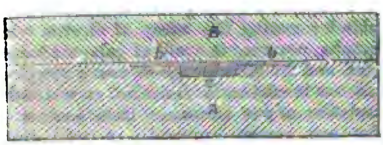


Fig. 2ᵃ.

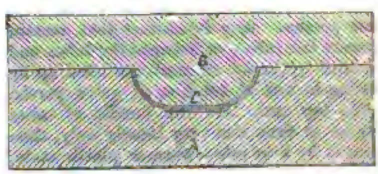
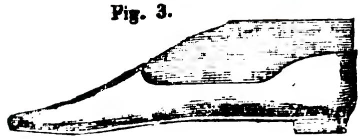


Fig. 3.



as also the rest of the back to such a temperature, that by pressing them together a perfect adhesion may be effected. The piece last added, may be either plain or figured, and the figuring may be either done before the piece is put on or afterwards. Or,

instead of making the whole of the back of gutta percha as has been first described, it may be made partly of gutta percha, and partly of other substances, as for example, some of the pieces through which the hairs or bristles are drawn may be of wood or bone, or leather, or felt, or canvas, and the others of gutta percha; or the outer top piece may be of velvet, or silk, or wollen cloth, but in such a case as the last, the fabric must be coated on the underside with a solution of gutta percha, or caoutchouc, and well warmed before it is applied.

In making round stocks for brushes I proceed as follows. I take a solid stick of gutta percha, which has at the root end grooves cut or cast on it all round, I insert the parcels or knots of hairs, or bristles in these grooves, and then pour over them a warm solution of gutta percha. When this solution has cooled, I wrap a piece of sheet gutta percha once round the grooved part which encloses the hairs or bristles, and then, upon that a second piece, also of one thickness, causing each piece to adhere to the stock by warmth and pressure, as in similar instances before explained, and taking care so to adjust the pieces that they shall break joint with one another, and come each close together at the edges. And finally, I bind the whole together by means of gutta percha thread, or cord, or of twine, saturated with gutta percha, or wire coated with gutta percha. The body of the stock may be made of wood, or metal grooved as aforesaid, for the reception of the hairs or bristles, but I prefer making the whole of gutta percha.

Another mode of making round brushes consists in drawing the knots of hair or bristles through small tubes of gutta percha and tying a number of these tubes together in a circular form by means of gutta percha thread or cord, or twine, saturated with gutta percha. Any interstices that remain between the tubes, or between the tubes and the binding thread or cord, are filled up by pouring in a thick solution of gutta percha at the top end. Or the bundle of tubes may be at first tied very loosely only, then brought by heat into a warm or plastic state, and afterwards compressed into one compact circular body by rolling or by clamping them in a die of suitable dimensions (first withdrawing the thread used in the tying). The bandle may be either of solid gutta percha, or any other suitable material, and attached in any convenient way.

A round brush may be made in the way last described of a single knot of hair or bristles; but the tube in this case is made to bulge out a little at the sides, and of smaller diameter at bottom than at top. The top, or root end of the knot is covered over with gutta percha solution.

The mode before described of drawing the kno s through tubes of gutta percha may be also applied to the making of flat brushes The tubes containing the knots are arranged in one or more straight lines, then secured between two clamping boards, dipped into hot water and pressed together till they are formed into one compact solid mass.

3. I paint and print articles and fabrics made in whole or in part of gutta percha, and also other articles and fabrics of any colour or colours, and of any design or pattern, by using as a vehicle for the pigments or other colouring matters, the following compound: I take one part of caoutchouc and one part of gutta percha, each dissolved in spirits of turpentine (or any other suitable solvent), add thereto four parts of gold-oil size; mix the whole of these materials together in a bath of hot water, and then thin with spirits of turpentine, it being of advantage to use this compound in a very thin state. The pigments or other colouring matters should be well ground up in turpentine before they are mixed with the vehicle. The proportions which I have given are such as I find to answer on the whole best in practice.

In carrying out the different improvements which I have hereinbefore specified, I uniformly prefer employing such gutta percha or compound of gutta percha, as has been prepared by boiling or by masticating it in a bath of water and muriate of lime, but to this mode of preparation I do not here lay any claim.

4. The better to adapt gutta percha to the manufacture of various articles and fabrics, I prepare and combine it with other matters and things according to the several new and improved modes next to be described.

To obtain a gutta percha compound suitable for coating the wires of electric telegraphs, covering the cells of galvanic batteries, and for other purposes where complete electric insulation is desirable, or where the isolation of one substance from another is for any reason required. I take gutta percha hot from the masticator (preferring as aforesaid that which has been previously boiled in the muriate of lime bath) roll it between heated cylinders, and during the rolling sift thereon common rosin in a pounded state, so as to mix the same intimately with the gutta percha. Or I dissolve equal portions of gutta percha and common rosin in coal naphtha or any other suitable solvent. Or I dissolve the gutta percha and the rosin separately, and then mix the two solutions together. The product resulting from any of these mixtures

should be kept hot in steam kettles, and it may be either applied to the articles to be protected by a brush or spatula, or the articles may be dipped in it, or drawn through it, and wound off upon suitable revolving racks or open cradle reels.

To make a compound preferable to any yet in use for casting and moulding purposes, for waterproofing cloth leather and other articles and fabrics, and for coating ships' bottoms, lining tanks and cisterns, &c., I mix with gutta percha which has been first boiled in a bath of muriate of lime, and then masticated thoroughly, and while it is yet undergoing the process of mastication, a compound of shell-lac and borax, adding the same by little and little as the mastication proceeds, and using more or less, according as it is desired to make the compound more or less tenacious. The compound of shell-lac and borax is prepared by boiling in a steam kettle over a common fire five parts of stick lac, or shell lac, or seed lac, with one part of borax, in so much water as will just cover these materials, and evaporating the water according to the thickness desired to be given to the compound. Any desired colour may be given to this mixture of gutta percha, shell lac, and borax, by mixing the requisite pigment or colouring matter with the shell lac and borax compound.

To make metal studded sheets of gutta percha, suitable for being cut up and formed into shoe soles and heels, clogs, pattens, and other articles, I take a flat piece of hard wood, and tack to the upper surface thereof a number of nails or studs of a wedge-shape, or with a double head (that is, with two heads, one over the other, and a space between them); I then place this piece of wood, with the nails or studs uppermost, in a metal chase or frame, and press gutta percha, in a warm and plastic state, down upon the nails or studs, so as to bury the same completely, taking care to do this gradually, and to exert the pressure straight downwards, so as not to throw the nails or studs out of their vertical position. The mass is then kept under considerable pressure till quite cold, after which the wooden foundation is removed. The sheets thus produced are afterwards cut up into pieces of sizes and shapes suitable for use, and may be readily attached by their gutta percha surfaces to any other surfaces by mere warmth and pressure, as in other cases before mentioned.

And having now described the nature of my said invention, and in what manner the same is to be performed, I declare that the improvements which I claim as constituting my said invention are as follows:—

First. I claim the mode of making shoes and goloshes of gutta percha, combined with other materials first before described, in so far as regards the combination of elastic or flexible foundations with gutta percha soles and uppers.

Second. I claim the employment of glass moulds to give a polish to the exterior or parts of the exterior of shoes and goloshes made in whole or in part of gutta percha, as before described.

Third. I claim the employment of metal springs, inserted, as before described, in shoes and goloshes made in whole or in part of gutta percha, in order to give springiness to the same.

Fourth. I claim the making of backs and stocks for brushes in whole or in part of gutta percha, as before described and exemplified.

Fifth. I claim the employment for painting, printing, or otherwise applying colours to articles und fabrics made in whole or in part of gutta percha, and also to other articles and fabrics, of the particular compound or vehicle hereinbefore specified, but without limiting myself to the exact proportions in which each of the materials has been directed to be used in such compound or vehicle, inasmuch as the said proportions may be varied without affecting the general result.

And, *Sixth.* I claim the employment, for all manufacturing purposes to which the same are applicable, of the several other improved preparations and compounds of gutta percha specified under the fourth head of this specification, each in the peculiar combination of materials of which the same consists, and the peculiar process or processes by which it is prepared.

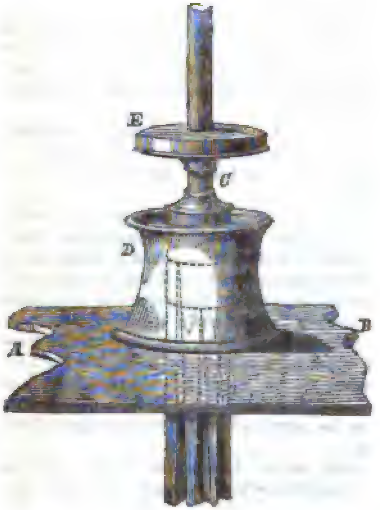
PISTON VALVE.

Sir,—It has been found that the construction of a valve resembling the key of a flute, as applied to steam boilers, is liable to accidents. Experience has shown that the surfaces stick or adhere together, so that the valve will not open when the safety of the boiler requires it, notwithstanding that a fully sufficient power of steam is acting upon it to produce this effect—that is, according to calculation. Many boilers have burst without any well explained cause, since the surfaces were subsequently ascertained to have been clean, and no obstruction in the working of the machinery could be detected.

The valve which I proceed to describe, I term the "piston valve," from its working in a stuffing-box, and rising like

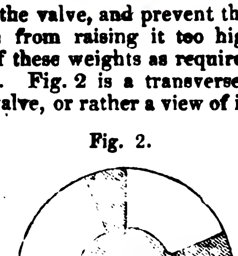
the piston in the cylinder of an engine. AB, fig. 1, is a portion of the top of the boiler; C, the piston valve, working in the stuffing box, D. The best construction of the latter would probably be that of being bored out of metal, and the piston ground in steam-tight. E, is a weight

Fig. 1.



to load the valve, and prevent the steam beneath from raising it too high. As many of these weights as required could be used. Fig. 2 is a transverse section of the valve, or rather a view of its lower

Fig. 2.



end. Fig. 3 is the piston valve, taken out of the stuffing box. The principle of its construction is this:—That the higher the piston rises, the greater will be the escape of steam. To effect this object, three or four grooves are taken longitudinally out of its sides, first by cuts towards the centre, and secondly by cuts parallel and concentric with the circumference. These grooves are pointed at the top, and get wider towards the bottom. It will be observed that the first commences near the top, at *a*; the second lower, at *b*; the third lower than the second, at *c*; and the fourth, *d* (if there are so many), still lower than the third. Supposing, then, that the piston-valve is put into its place in the stuffing box, and that the steam exerts itself within the boiler, the piston will be raised. If raised to the commencement of the first groove, at *a*, fig. 3, the steam will begin to escape; and a greater quantity will be let off, if the piston rises further as the groove increases in size. Should it be raised to *b*, the steam will begin also escaping from the second groove, and so on in the same way with the others.

Fig. 3.

Fig. 4.

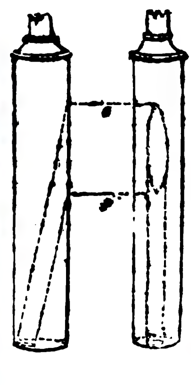


Fig. 5.

In fig. 4 another plan for the escape of the steam is given, where a cylindrical hole is bored diagonally through the length of the piston. The range of motion is here intended to be between the letters *e* and *f*. This hole might be made eliptical, so as to give a greater range and a longer escape. But lest the escape of the steam on one side only, should be likely to obstruct the free working of the piston, in fig. 5, the hole is bored through the centre of the lower part, but branches into two near the top, thereby giving two escapes, at opposite points, *g* and *h*.

The principle of the piston valve suggested itself one day when holding a pencil between the lips, and forcing it out of the mouth by means of the breath. In order to prevent the possibility of the surfaces from sticking, the piston valve

might be kept in a state of constant rotary motion, by connecting it with a fan wheel placed within the feed pipe, between the boiler and the cylinder, the stream of steam acting upon the fans; or it might be connected with the machinery of the engine. The same end might be attained by placing the fan-wheel at some convenient part on the outside of the boiler, and a current of steam turned upon the fans by means of a cock. But the objection to this latter plan is this—that the steam issuing from the cock would be wasted. I am, &c.,

PETER HUTCHINSON.

Sidmouth, Devon, Oct. 19, 1848.

GEOMETRY OF THE LINE AND PLANE.—BY T. S. DAVIES, F.R.S., L. AND E., F.R.S.A., ROYAL MILITARY ACADEMY, WOOLWICH.

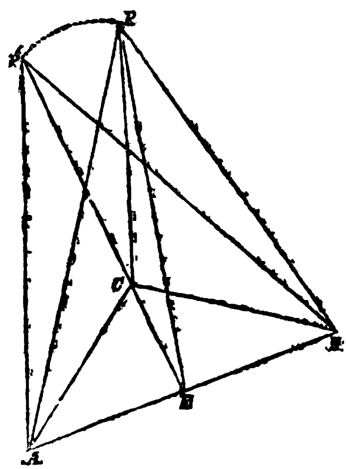
(Continued from page 440.)

PROP. XLVI.

Let CD be a line perpendicular to a plane ABC meeting the plane in C; and let A, B, be two points in that plane: it is required to find the point in CD to which if lines be drawn from A and B, they shall contain the greatest angle.

The problem will divide itself into two general cases, adapted to the circumstances that CE being drawn perpendicular to the line AB, it shall meet AB in E so that E shall be in AB or in AB produced, respectively.

CASE 1. Let E lie between A and B, Join AC, BC: then ACB is the greatest angle formed by lines from A, B, to meet in CD.



For let P be any other point in CD, and join PE; make EP′ equal to EP; and join AP′, P′B,

Then, since PCE is a right angle, it is greater than CPE; and hence PE is greater than CE, and P′ lies more remote from E than C does. The point C is therefore within the triangle AP′B; and (*Euc.* i. 21), the angle ACB is greater than AP′B.

Again, PE is perpendicular to AB. or AEP is a right angle. Whence the triangles APE, AP′E have the sides AE, EP equal to the sides AE, EP′, and their included angles AEP, AEP′ also equal: and therefore the angle APE is equal to AP′E.

Similarly the angle BPE is equal to BP′E; and consequently the whole angle APB is equal to AP′B.

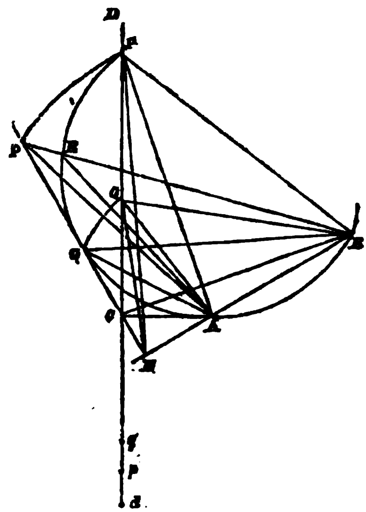
But ACB is greater than AP′B, and consequently greater than APB.

The same demonstration evidently applies when P is taken on the other side of the plane ACB: and when E falls at A or B, the demonstration becomes still more simple in its details.

SCHOLIUM.

When PA, PB are the lines forming an angle to be projected on a plane which meets them in A and B, and when the perpendicular from P to the base AB does not fall in AB produced, the projection of the angle is greater than the angle itself. The general assumption referred to above is therefore always true in this case; and it will be seen that this is not the only case in which it is accurate.

CASE 2. Let the perpendicular CE from C to AB meet AB *produced*, in E. Through A and B describe a circle to touch EC *produced* in the point Q′; in CD take Q so that EQ shall be equal to EQ′, and join AQ, QB. Then AQB is the greatest angle that can be formed by lines drawn from A and B to meet in CD, on the same side of the plane ACB.



For, let P be any other point in CD on the same side of the plane ACB; and in EC produced take EP′ equal to EP: the other lines being drawn as in the figure to join the several points already defined, and R being the intersection of P′D with the circle ABQ′.

Then since AQ′B, ARB are angles in the same segment of the circle AQ′B, they are equal; and since in the triangle P′AR the angle ARB is exterior, it is greater than AP′B. Wherefore AQ′B is greater than AP′B.

Again, by reasoning similar to that in the first case, it may be shown that APB is equal to AP′B, and AQB equal, to AQ′B; and hence it follows that AQB is greater than APB.

SCHOLIUM.

In this case, then, the assumption is erroneous, as the orthographic projection represented by ACB is less than the projected angle AQB. This is the case when P′ is taken at C, and P coincides with P′.

In order to specify the varieties of this general case, one or two remarks may be usefully appended. Let us then suppose the plane ACB to be horizontal, and CD to be the part of the line *above* ACB; whilst the part *below* ACB is denoted by C*d*. Also, let C*q*; C*p* be equal to CQ, CP. Then,

(α). The angles made by inflecting lines from A and B to points in CD continually increase as the point to which the lines are inflected approach towards Q from D. After passing Q, the angles continually diminish till the point of inflection arrives at C. The angles then again increase till the point arrives at *q*; and, finally, in passing further downwards the angles diminish incessantly. The extreme limits of the magnitudes of the angles in both directions is zero.

The problem, then, in this case has two maxima solutions and one minimum—using these terms in their modern mathematical sense.

(β). If a circle described through A, B, C, and cut the line EC produced in P′; and if P be constructed so that EP shall be equal to EP′: then the orthographic projection ACB of the angle APB will be equal to the angle APB itself.

(γ). If a circle be described through A, B to cut CE produced between C and Q′, in H′, and again in K′; and points H, K corresponding to them be taken in CD (these points are omitted in the figure to prevent confusion): then the angles AHB, AKB will be equal to one another. Whence two equal angles situated in different planes passing through AB may have the same orthographic projection. The same is obviously true of two angles A*k*B, A*h*B on the other side (or *below*) the plane ACB.

(γ). If the circle through A, B touching CE, touch it in C, the point Q coincides with C; and the angle ACB will be the greatest possible.

In this case, then, the ordinary assumption is correct as to the projection being greater than the projected angle. It is this which gives rise to the limitation expressed in the construction of the second case.

(ε). If the circle through A, B touch CE between C and c (c taken equidistant E with C) the point determined by it is excluded from consideration; since no corresponding point could be constructed in CD, CE being the shortest line that can be drawn from E to CD. In this case, then, the usual assumption is also accurate.

(*To be continued.*)

MESSRS. BARLOW AND FOSTER'S PATENT IMPROVEMENTS IN ELECTRIC TELEGRAPHS AND APPARATUS.

[Patent dated April 27, 1848; specification enrolled October 27, 1848.]

The improvements specified under this patent consist, firstly, in coating, and thereby protecting and insulating the wires of telegraphs, with gutta percha, or a compound thereof. To coat such wires with gutta percha is of course not new, but to coat them with the particular compound specified may possibly be so. The compound consists of one part by weight of New Zealand gum and one part of milk of sulphur added to eight parts of gutta percha, by little and little, while in a kneading trough, and at a temperature of 120 Fahr. The coating is effected as follows:—Two pairs of rollers are made to revolve, by means of suitable gearing, at one uniform speed, and each pair is provided with a pipe fitted steam-tight to one end of their axis, through which pipe steam is admitted at pleasure, which serves to bring the rollers to a temperature sufficient to soften partially two bands of gutta percha passed between them. Then, there is another pair of rollers which have their surfaces cut with semicircular grooves; the grooves of the one roller corresponding, or falling right over those of the other. The wires to be covered are wound upon reels, from which they pass between the second pair of rollers. The bands or fillets of gutta percha are passed between the first pair of rollers, (and are so brought into an adhesive state,) and the two bands of gutta percha, with the wires between them, are in this state passed between the second pair of rollers, by which the fillets of gutta percha are made to adhere together, and consequently to envelop the wires.

Secondly. The patentees propose, so to govern the currents of electricity, as to cause the pulsations to indicate different signs and symbols. The pulsation of one current of electricity is made to move forward the axle or other recipient of motion to a certain distance representing five units: and that of the other current a distance in the reverse direction, representing four units; and the conjoined pulsations of the two currents, a distance represented by one unit. Thus, supposing A and B to represent the two currents, the sign will be indicated by

1st. 1 pulsation of A,
2d. by 1 pulsation of A and B,
3d. by 1 pulsation of B,

and so on. The mechanical arrangements by which this is effected could not be rendered intelligible without engravings.

Thirdly. The patentees describe an electric telegraph apparatus for indicating the passing and time of passing of a railway train. A dial is pierced with 60 holes at regular distances, in which holes small plugs are placed. This dial is made to revolve once every hour. A metal spring presses against the face of the dial, and has the effect of thrusting back any plug that may have been protruded. Above the dial is an electro-magnet, which attracts, on the passing of an electric current from the station which the train has just passed, one end of a lever, the other end of which protrudes the plug immediately underneath it beyond the face of the dial, so that the attendant is enabled, by looking at the dial, to see whether the train has passed the station, and what time has elapsed since it passed.

The claims are—

1stly. The "modes" of coating and insulating the wires of electric telegraphs with gutta percha or its compound.

2ndly. The governing the currents of electricity so as to cause each pulsation thereof, separately or conjoined, to indicate different signs or symbols.

3rdly. The apparatus for indicating the passing and time of passing of railway trains.

MATHEMATICAL RECREATIONS.

Sir, — By your permission, I would point out to "I. L.," who in your last Number has favoured you with certain solutions in mensuration, that I imagine the calculations could be more explicitely effected as follows:

Example 1.—Let x = side of the farm in yards,

$$\therefore \frac{x^2}{1210} = \text{number of roods of land.}$$

$$\therefore \frac{x^2}{1210} = 4.\,x.\,\frac{2}{11} \text{ or } x = 880 \text{ yards.}$$

Example 2.—$4x$ = yards of fencing,

$$\therefore \frac{x^2}{4840} = \text{area in acres,}$$

$$\therefore \frac{x^2}{4840}.\ \frac{40}{3} = 4x.\ \frac{2}{11}.\ \frac{5}{4},$$

$$\text{or } x = \frac{10}{11}.\ \frac{363}{1} = 330 \text{ yards.}$$

Example 3.—Let $4x$ = inches of perimeter and number of sovereigns,

$\therefore x^2$ = number of square inches,

$\therefore 2x^2$ = number of shillings.

$\therefore 2x^2 = 80x$ and $x = 40$ and number of sovereigns = 160.

Example 4.—Let x = a side of $\triangle$ in yards.

$$\therefore \text{Cost of railing} = 3x \cdot 21.$$

$$\text{Area of } \triangle \text{ in feet} = 9\,\frac{x^2\sqrt{3}}{4}$$

$$\text{Cost of paving} = 9\,\frac{x^2 \cdot \sqrt{3}}{4}.\ \frac{2}{3} = 63x,$$

$$\therefore x = 14\sqrt{3} = 14\,(1{\cdot}7320508)$$
$$= 24{\cdot}2487112 \text{ yards.}$$

I am, Sir, yours, &c.,

J. W.

Brighton, Nov. 13, 1848.

TEST FOR ORGANIC MATTERS IN AQUEOUS SOLUTIONS.

M. Alph. Dupasquier proposes the chloride of gold for the purpose of detecting organic matter when present in water in such large proportions as to make it unhealthy to drink, or improper for use in the arts.

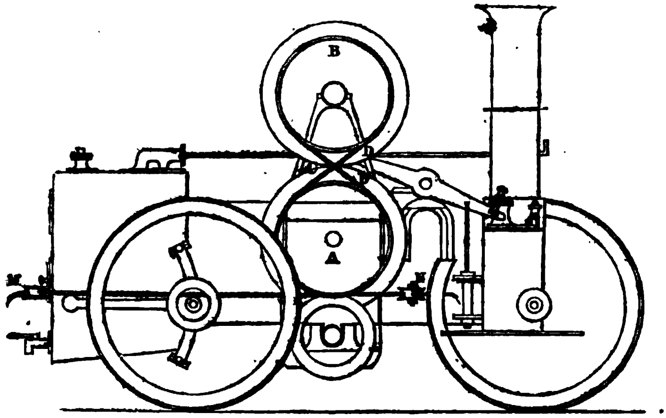
Into a small glass vessel he introduces from 20 to 25 grammes, (300 or 400 grains) of the water to be tested, and adds a few drops of a solution of chloride of gold (carefully freed from excess of acid), so as to give it a slight yellowish tint; the liquid is then boiled. If the water contains only the quantity of organic matters common to drinkable waters, it retains its colour even after long boiling. But if, on the contrary, it contains an abnormal quantity, it first turns brown, then takes a violet or bluish tint, which indicates the decomposition of the gold salt by the organic matter. By prolonging the ebullition, the violet or bluish tint becomes deeper and deeper, if the proportion of organic matter is considerable. But a slight brownish or greenish tint is sufficient to indicate certainly that the quantity of organic matter is greater than usual.

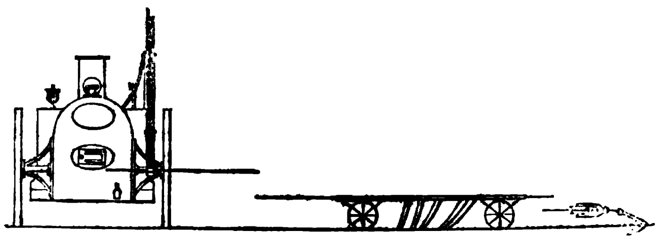
The salt must be used without excess of hydrochloric acid which interferes with the reaction.

Very often, during a somewhat prolonged ebullition of the liquid, the oxide of gold precipitates, owing to the re-action of the carbonate of lime upon this salt; then, if the chloride of gold is not in excess, the liquid is decolourised; or if in excess, the shade of colour may be changed by a slight cloud which appears. To distinguish this reaction from the former, it is only necessary to add one or two drops of pure hydrochloric acid, which will immediately dissolve oxide of gold, and the colour is restored. But when the gold has once been brought to the metallic state by the organic matter, it is not redissolved by the hydrochloric acid, and the liquid remains violet, bluish, brownish, or greenish violet, when there has been a tolerably great excess of chloride of gold. If, however, the liquid contains a trace of nitrate, if it be re-boiled the gold may be re-dissolved.—*Journal de Pharmacie et de Chimie, March*, 1848.

MR. OSBORN'S STEAM PLOUGH.

Our attention has latterly been called to some experiments recently made on the farm of Mr. Tyler, near Stratford, Essex, with a steam locomotive engine, constructed expressly for agricultural work, or steam haulage on canals, in conjunction with Mr. Andrew Smith's wire-rope. They were constructed by Mr. Wm. Curwood, engineer, of Whitechapel, under the patent of Mr. Osborn, King-street, St. James's. Although the majority of our agriculturists still ridicule the introduction of steam power for ploughing, and deprecate it as totally impracticable, it is gratifying to find there are men to be found who venture to step beyond the confined limits of present practice, and, aware of the universal power of steam, are anxious to second the inventions of science and the progress of the arts. In the first trial, a pair of these peculiarly constructed steam engines were placed opposite each other, about 120 yards apart, with a sufficient length of wire-rope between them,





the surplus being coiled round the beam of one of Lowcock's two-way ploughs. This trial, although not successful, proved that the conditions of the two modes of draught differ essentially—horse draught being upwards, and exercising a direct control, by its proximity to the plough—whereas, the draught by steam power is distant and downwards, and exercises no direct control on the plough; hence the experiment was instructive. Another trial was made, extending the distance to 210 yards between the engines, when, with both a Kent turn and an Essex rest plough, very good work was accomplished. The subsequent trials were made with a two-wheel single engine, the wire-rope being returned through a pulley anchored opposite the engine, and were equally successful as regards the work done. When a common swing plough was used, the downward draught buried it beyond the necessary depth at once. From these rude trials, with an engine of 10 horse power, which is locomotive, or can be drawn by two horses, we think there is little doubt of the practicability of the plan, as now tested; but on the question of its economy, nothing but actual experiments, on a large scale, with suitable implements, can determine.

These engines possess great advantages in being applicable to thrashing and other agricultural purposes, and can be moved from farm to farm, or from field to field, with the greatest facility. They are of the usual form, but superior to any yet made for agricultural purposes, both as to arrangement and workmanship. The mode employed for taking up the wire-rope constitutes the patent. A pair of grooved riggers, 30 inches in diameter, with projecting circles, are placed tangent to each other—the projecting circles forming friction wheels. This pair of riggers is placed one above the other, by the side of the boiler, and secured to it on a frame by two strong iron straps, to which also all the gearing is framed. The cylinders are vertical, and encased in the smoke-box, giving motion to the crank-shaft by beams and side rods. The crank-shaft traverses under the boiler, and communicates the necessary motion to the lower rigger by a spur and pinion wheel. On the the opposite end of the crank-shaft are keyed, when wanted, a drum and boss, for a universal joint; and the engine is rendered locomotive by a pair of stubb wheels and chains, connecting them with the crank-shaft. The compactness of the engine is admirable; for, while it is equal to 10 horse power, and performs three distinct operations, its compass is only 10 feet by

6½ feet, the height of boiler being 5 feet. The wire rope is wound round the riggers in form of the figure of 8, and all sawing and abrasion prevented; and this plan presents a great advantage in not requiring perfect tension, but will take up a slack rope without the least slip on the grooved riggers.

[A description of Mr. Osborn's steam-ploughing machine, rather more complete than the preceding, was given in this Journal for July 30, 1848, accompanied with a full exposition of the economical advantages to be anticipated from its adoption. — ED. M. M.]

THE LATE WILLIAM JAMES, THE FIRST GREAT PROMOTER OF THE RAILWAY SYSTEM, AND HIS CONNECTION WITH GEORGE STEPHENSON.

In recently noticing (*ante*, p. 401) the comparative claims of William James and George Stephenson to the honour of having given the first decisive impulse to the modern railway system, we stated that we had been unable to find any trace of the patent connection stated by a "Staffordshire Miner" to have subsisted between these two gentlemen. We have since received from a member of Mr. James's family a copy of a document which clears up the doubt hanging over this point, and shows, that though Mr. James was not actually a joint patentee with Mr. Stephenson, he held so prominent a position in the world in respect to railway enterprise, as to make it worth Mr. Stephenson's while, to assign to him a very considerable interest in his railway patents, in consideration of "his recommendation and best assistance." We give the document in full:—

"Know all men by these presents, that we, William Losh, of the town and county of Newcastle-on-Tyne, ironfounder, and George Stephenson, of Killingworth, in the said county of Northumberland, Esq., in consideration of £5 of lawful money of Great Britain, to us paid at or before the sealing or delivery of these presents, and in consideration of William James, of West-bromwich, in the county of Stafford, miner and engineer, *giving his recommendation and best assistance for the using and employing the locomotive engines* for which we, William Losh and George Stephenson, have obtained two letters patent, on such terms as we shall by writing direct and appoint, we, the said Losh and Stephenson, have granted and assigned, and by these presents do grant and assign unto the said William James, his heirs, administrators, and assigns, one fourth part or share of our rights and patent in the exclusive use of the locomotive engine for working on railroads, secured to us in and by certain letters patent of his late Majesty, and of the profits arising from the granting the use thereof to any other party or persons whomsoever. Such fourth part or share of the use, right, interest, and profits to be confined to engines made, used, or sold in that part of England and Wales lying south of a line drawn from the town of Liverpool to the town of Hull, to have and to hold such fourth part or share of the said patent, right, and profits from the date hereof unto the said William James, during the term of the said letters patent, given under our hands and seals this first day of September, 1821.

"WILLIAM LOSH.
"GEORGE STEPHENSON.

SPECIFICATIONS OF ENGLISH PATENTS ENROLLED BETWEEN THE 11TH AND 18TH OF NOVEMBER, 1848.

VINCENT PRICE, Wardour-street, Soho, Machinist. *For certain new or improved mechanical arrangements for obtaining and applying motive power.* Patent dated May 11, 1848; specification enrolled November 11, 1848.

Mr. Price appears to have strange notions about the meaning of words—notions which we fear will prove rather dangerous to the validity of his patent should that ever become a matter of question (which, however, we do not much fear). Improvements in velocipedes and driving lathes may pass muster as pertaining to the "applying," though not to the "obtaining" of "motive power;" but what are we to think of this pretentious patentee's including in the same category, improvements in mincing meat, slicing turnips, cleaning knives and forks, washing clothes, snuffing candles, and cleaning pens? To suppose that the title of this patent can cover such things as these, is absurd.

1. Mr. Price's improvement in velocipedes consists in dispensing with cranked axles, and substituting two ratchet-wheels attached to the straight axle of the driving-wheels, and caused to revolve by the action of pauls, which are made to alternately take in and out of the teeth of the ratchet-wheels, by means of suitable apparatus worked by treddles or levers.

2. The same arrangement as the preceding, but slightly modified to be applied to driving lathes.

3. The mince-meat invention consists of a chopping-board, hollowed out, and caused to rotate by means of a central vertical axle, to the top end of which is fastened a winch.

handle. Over this board is placed an axle carrying a certain number of circular cutters, which are kept at a convenient distance from each other by loose collars, which serve to cleanse the cutters from any substance that may adhere thereto.

4. The same machine, enlarged and modified, is to be applied to the slicing of turnips and other vegetables.

5. Mr. Price's knife-cleaner consists of a vertical cylinder, covered with felt or other suitable elastic material on its periphery, placed inside another vertical cylinder, which is composed of upright laths, covered on the inside circumference with felt. The pieces of felt are so arranged as to lap over one another, and to be almost in close contact with one another. Above both cylinders is placed a circular plate with holes in it, through which the blades of the knives are passed, and between the felted surfaces of the two cylinders, which are supplied with emery or other cleansing material. The circular plate is made to revolve with the knives, which are thereby effectually cleansed.

6. A knife-cleaner, of another form, consists of two horizontal rollers, round which are passed two endless bands, one over the other. These rollers are made to revolve together with the bands between which emery or other cleansing matter is supplied. The knives are inserted between the two bands, and there held fast until sufficiently cleaned.

7. The fork is distinct from the knife-cleaner. It consists of a frame, in which the forks are held fast, and which are made to travel backwards and forwards into and between a pair of brushes. The fork-carrying frame is supported and made to travel in a slotted frame, fixed in front of the brushes by means of eccentrics.

8. The washing apparatus consists of a water vessel, containing a horizontal cylinder composed of laths, in which the clothes, together with wooden balls weighted with lead, are placed. To one end of the axis is a winch-handle, by which rotary motion is communicated to the cylinder.

9. The "motive-power" snuffers consist of a cylinder, with a notch in it to receive the wick, and over which slides another cylinder. Against one end of the outside sliding cylinder presses a helical spring, which serves to keep it down over the inner one, which latter is perforated, to allow of the escape of air and prevent the candle being extinguished in the act of snuffing. When it is desired to snuff a candle, the outside sliding cylinder is drawn back, and the wick is received into the notch of the inner one, the sliding cylinder is suddenly released, and the helical spring allowed to act, which forces the outside cylinder down over the other one, and thereby cuts off the wick. [A true modern antique.]

10. The pen-cleaner consists of a pair of circular vertical brushes, which are fixed in a case, and made to rotate at pleasure, the pen being meanwhile held between them, and thereby cleaned.

11. Mr. Price specifies, lastly, a mode of working ships' pumps by means of two currents of water, which are taken in at the bows and allowed to escape at the stern. These two currents are conveyed through two tubes on either side of the interior of the vessel, and are caused to act therein upon two wheels similar to undershot water-wheels; and the rotary motion thus obtained is communicated by suitable gear, as required. [A plain copy, this, of Ruthven's well-known method of propelling.]

The patentee claims—The mechanical arrangements of apparatus or instruments before described, and any immaterial variations of them which practice may suggest.

George Armstrong, Newcastle-upon-Tyne, Esq., F.R.S. *For an improved water-pressure engine.* Patent dated May 11, 1848; specification enrolled Nov. 11, 1848.

Mr. Armstrong is the inventor of a system of applying to motive purposes, the water supplies of cities and towns when derived from high sources, which was first brought before the public in the pages of this Journal more than eight years ago (see vol. xxxii., p. 529), and has been since repeatedly noticed in our pages. (See vol. xliii., p. 402, — vol. xlv., p. 479.) His present patent is for an engine supposed to be better calculated than any hitherto proposed to carry that system into effect.

Mr. Armstrong claims, *firstly*, the application of things before well-known in steam engines to water pressure engines, such as placing the cylinders at right angles, or nearly so, to one another, and inverting them for the purpose of effecting an economy in speed.

Secondly. A peculiar kind of slide-valves in combination with other mechanical arrangements, by which he obtains an insistent pressure upon one side of the valve to compensate for the antagonistic pressure upon the other.

Thirdly. The application of vulcanized India-rubber to the top and bottom surfaces of the pistons and cylinders to overcome the difficulties arising from the non-elasticity of water.

And, *fourthly*, the employment of what he terms relief-valves in combination with the slide-valves to facilitate the working of the engine, by compensating for the non-elasticity of the water.

Mark Smith, Heywood, Lancashire, Power-loom maker. *For certain improve-*

ments in looms for weaving. Patent dated May 11, 1848; specification enrolled November 11, 1848.

The patentee claims,

1. A combination and arrangement of parts forming an improved apparatus for varying the position of the shuttles, used in weaving ginghams and other fabrics requiring two or more shuttles,—the employment of pins of different lengths, and a guide-plate, when used in combination with the Jacquard apparatus, or pins of different lengths when in combination with the links of a Jacquard chain for the same purpose.

2. An apparatus for stopping the loom when the weft breaks.

3. An arrangement and combination of levers and catches actuated by pins of different lengths when in combination with the Jacquard apparatus, for varying the position of the shuttles arranged in circular or vertical boxes.

4. A tappet and forked lever, actuated by pins of different lengths, in combination with the chain of a Jacquard apparatus.

5. A "positive self-regulating apparatus" for letting off the warp from the warp-beam (the motion of which varies in proportion to the decreasing diameter of the warp wound upon the warp-beam) when used in combination with the apparatus (2) for stopping the loom when the weft breaks.

6. An improved self-acting pair of temples for stretching the cloth to the reeds.

CHARLES HANCOCK. *For certain improved preparations and compounds of gutta percha, and certain improvements in the manufacture of articles and fabrics composed of gutta percha alone and in combination with other substances.* Patent dated May 11, 1848; specification enrolled November 11, 1848.

For this specification see *ante*, p. 490.

THOMAS RESTELL, Tooting, Surrey, Watchmaker, and RICHARD CLARK, Strand, Westminster, Lamp Manufacturer. *For improvements in chronometers, clocks, watches, or other time-keepers.* Patent dated May 11, 1848; specification enrolled November 11, 1848.

The object of these improvements is—*Firstly.* To dispense with the detent springs, the lifting springs, and, in some cases, the balance springs of time-keepers, and to obviate thereby the necessity of having compensating balances and their requisite appendages. The arrangement by which the detent and lifting springs are superseded, consists chiefly in placing the centres of the balance wheel, the escapement wheel, and the detent upon the same right line. The face of the detent, which locks the teeth of the escapement, is composed of two curves, one of which only is concentric with the escapement wheel; and the axle of the detent carries a lever, which is furnished at one end with a ruby pin, flat on one side, and rounded on the other. A steel spring is fixed on the inside circumference, and between the arms of the balance, one end of the spring is bent and passed through the balance, so that it projects beyond. The pallet of the balance differs in no respect from ordinary pallets. The action is as follows:—On the revolution of the balance, the end of the spring strikes against the flat side of the ruby pin of the lever on the axle of the detent, which is thereby unlocked, and one tooth of the escapement wheel liberated. The tooth then passes along the compound curved surface of the detent until it arrives at the end, which it depresses, and consequently lifts the other, whereby the locking is again effected.

The patentees are enabled to dispense with the balance spring by a mechanical arrangement in which the balance is caused to make one entire revolution for the liberation of one tooth of the escapement wheel, and then to pause for a fresh impulse.

Secondly. The patentees describe an improved pendulum which is made of two bars or rods, one of brass and the other of steel in the proportion of five to three. They are screwed together at top with a disc interposed between them. The end of the steel bar is fastened to the bob, from which a chain, with a regulating screw at the end, is passed over a pulley, through the bars, and made fast to the end of the brass bar. The top portions of the bars are pierced with numerous holes, which serve to facilitate the adjusting of the bars. The object of these arrangements is to compensate for any increase or decrease in the balance springs which may arise from variation of temperature.

Thirdly. The patentee describes a mode of adapting musical boxes to clocks and other time-keepers, so as to play at certain regular intervals. The hour wheel of the clock is made to liberate (a little before the hour) by the interposition of a series of levers, the flyer of the musical box.

The patentees' claims are, 1. For the construction and arrangement by which the use of detent springs, lifting springs, and in some cases, balance springs, are dispensed with; and particularly the placing the centres of the detent, escapement wheel, and balance wheel on the same right line.—2. The mode of constructing balances or pendulums to compensate for the increase or decrease of balance springs by the variation of temperature. And, lastly, the mode of adapting a musical box to clocks or other time-pieces, so that it shall play at stated intervals as long as the clock keeps going.

WEEKLY LIST OF NEW ENGLISH PATENTS.

James Anderson, of Abbotsford-place, Glasgow, North Britain, starch manufacturer, for a certain improved mode of separating the different qualities of potatoes and other vegetables. November 11; six months.

Alexander Parkes and Henry Parkes of Birmingham, for improvements in the manufacture of metals and alloys of metals, and in the treatment of metallic matters with various substances. November 11; six months.

John Browne, of Osnaburgh-street, Middlesex, gentleman, for improvements in fire-escapes, and in apparatus to facilitate persons employed in cleaning windows. November 11; six months.

Alexander Balfour, of Dundee, Scotland, leather merchant and manufacturer, for improvements in apparatus for cutting metal washers and other articles, and in the construction of buffers. November 16; six months.

Samuel Adams, of West Bromwich, Stafford, organist, for improvements in mills for grinding. November 16; six months.

William Wilkinson, of Yarrow, near Gateshead, Durham, coke manufacturer, for certain improvements in the construction of coke ovens, and in the machinery or apparatus to be connected therewith. November 16; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Nov. 13	1665	Thomas Taylor	Manchester	The scarf wrapper vest.
"	1666	Benjamin Nicoll	Regent-circus	Shirt.
14	1667	William Evans	Banbury	Mangle.
15	1668	Henry John Nicoll and Donald Nicoll	Regent-street and Cornhill	Wrapper coat, and feet protector.

Advertisements.

NOTICES TO CORRESPONDENTS.

A stamped edition of the Mechanics' Magazine, to go by post, price 4d., is published every Friday, at 4 o'clock, p.m., precisely, and contains the Claims of all the Specifications Enrolled, New Patents sealed, and Articles of Utility registered during each week, up to the time of going to press. Subscriptions to be paid in advance. Per annum 17s. 4d., half-yearly 8s. 8d., quarterly 4s. 4d. Post-office Orders to be made payable at the Strand Office, to Joseph Clinton Robertson, of 166, Fleet-street.

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Edited by J. C. Robertson, 166, Fleet-street.

SALTER'S PATENT WATER-DISTRIBUTING CART.

Fig. 2.

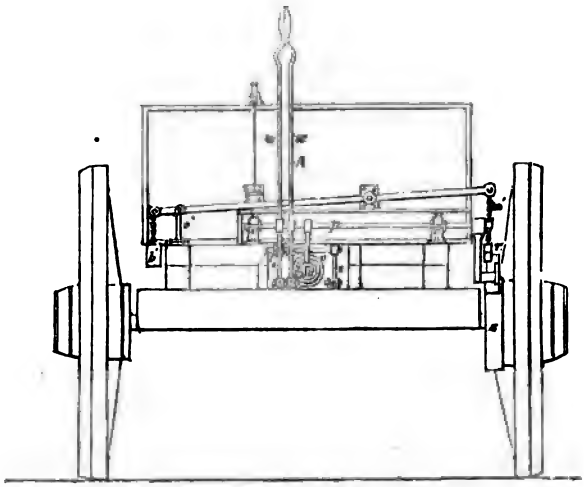
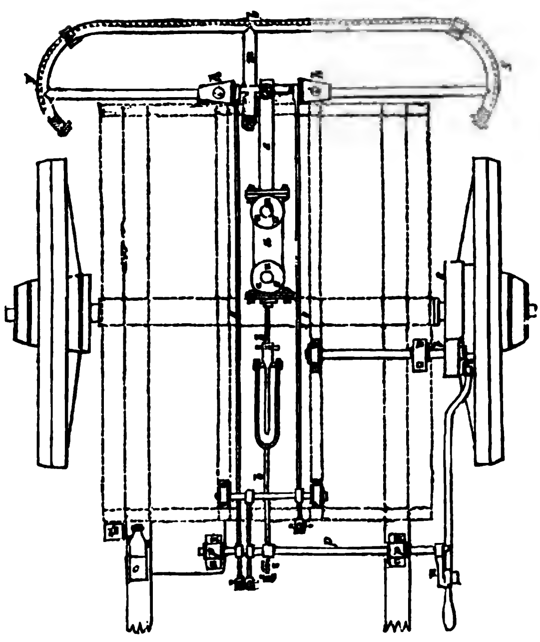


Fig. 1.



SALTER'S PATENT WATER-DISTRIBUTING CART AND SELFACTING DRAIN-FLUSHING APPARATUS.

[Patent dated April 27; 1848. Patentee, Roger George Salter, of Birkenhead, Surveyor. Specification enrolled October 27, 1848.]

The water-distributing cart which forms the subject of the first branch of this patent, is distinguished from those in common use by two valuable features; first, the outflow is made to depend on the progression of the cart; and second, the width of space over which the water is distributed, may be varied at pleasure within certain limits, say from one yard or less to fourteen yards and upwards. We call it a water-cart in conformity with popular language; but it will be obvious, that it will answer equally well for the distribution of manures in a liquid state.

Fig. 1 is a plan of the cart; fig. 2, a front elevation of the same; fig. 3, a longitudinal section; and fig. 4, an external side view of the part sshown in fig. 2.

Fig. 3.

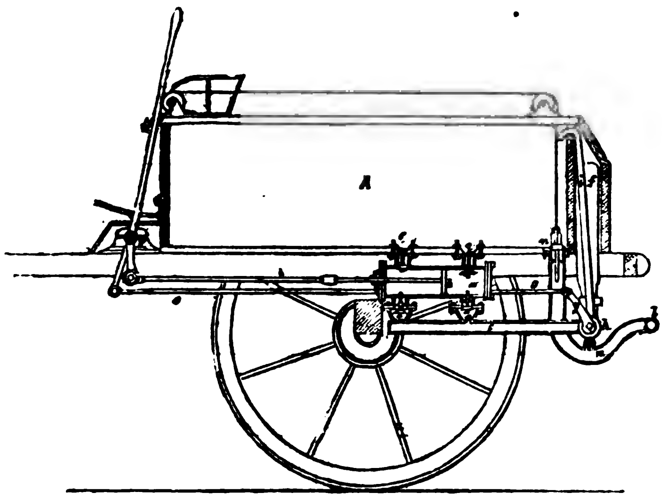
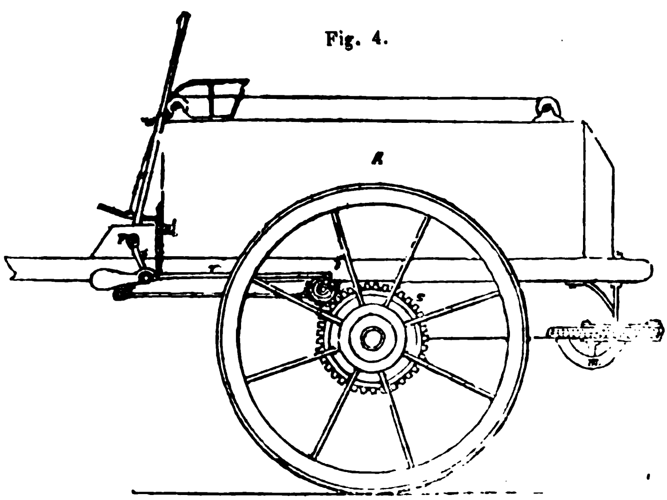


Fig. 4.



A, is the tank or cistern for holding the liquid substance to be distributed; *a* is a cylinder, which is fixed horizontally beneath the tank; *bb*, a piston and rod, which work within the cylinder; *s* is a cog-wheel, which is fixed on the axle of the cart, and gives motion to the piston and rod, *b*, through the medium of the pinion, *t*, connecting-rod, *r*, way-shaft, *p*, (supported by the pedestals, *vv*), and cranks, *z*; *cc* are valves, through which the liquid substance is admitted from the tank into the cylinder; and *dd*, valves by which it is discharged from the cylinder into a delivery-pipe, *e*, by which it is transmitted to the side or end distributing pipes, *gg*; *f* is an air pipe or chamber; *hh* are two three-way cocks, which command the passages between the feed-pipe, *e*, and the side distributing pipes, *gg*; *i* is a pipe which leads from one way of each cock back to the tank (for a purpose to be afterwards explained); *kk* are union joints, which connect the side distributing pipes, *gg*, with the back distributing pipe, *e* (which pipes, however, have no communication internally at the union joints), *l* is a back distributing pipe, which is supplied from the bottom of the cistern through a pipe, *m*, and valve, *n*; *oo*, are crank-rods, by which the three-way cocks, *hh*, are connected to and worked by the levers or handles, *ww*, in front of the cart.

The action or mode of operation of the machinery is as follows: As the wheels of the cart revolve, the cog-wheel, *s*, on the axle, gives motion through the pinion, *t*, connecting-rod, *r*, and way-shaft, *p*, to the rod and piston, *b b*. The piston in its motion closes one of the supply valves, *c c*, and opens one of the discharge valves, *d d*, and *vice versâ*, at every stroke; and by this alternating action the liquid substance is forced through the feed-pipe, *e*, into the side-distributing pipes, *g g*. The air-chamber, *f*, preserves an equable pressure in the pipes while the three-way cocks, *h h*, serve to regulate not only the quantity of liquid allowed to pass through to the side-distributing pipes, *g g*, but the width of the space irrigated. Any portion of the liquid which passes through the cylinder, and may not be wanted for irrigation, is returned into the cart through the pipes, *i i*. The tops of the working levers, *w w*, are so arranged as to form but one handle, but by having a bow handle formed beneath, each treadle or lever can be worked separately. The connecting-rod, *r*, is put in or out of gear, as required, by means of a lever, *x* (see fig. 4), one end of which is attached by a chain, *a′*, to the rod, *r*, while the other end has suspended from it a weight, *b′*, and is also attached to a treadle, *c′*. When the treadle, *c′*, is pressed down it raises the lever, *x*, and lowers the chain, *a′*, and thereby allows the connecting-rod, *r*, to drop on to the crank, and set the piston and other machinery in motion, while by releasing the treadles from the pressure, the weight at the end of the lever is sufficiently heavy to raise the connecting-rod off the crank and throw it out of gear.

Mr. Salter's improvements in drain-flushing we shall give in our next.

THE ROYAL SOCIETY.

"Ye are like unto whited sepulchres, which appear indeed beautiful outward, but are full of dead men's bones, and of all uncleanness."

It seems to be the inheritance of corporate bodies that they shall become corrupt; and the scientific and literary corporations furnish no exception to this sad law of human nature. Whoever endows an institution, thereby inevitably creates abuses by the thousand; and every charter granted by the Crown,—every Act of Parliament giving peculiar privileges to a little knot of adventurers, is the sure prelude to public wrong and individual oppression. Corruption is as natural and as inevitable, to these endowed and privileged bodies, as it is to the "whited sepulchre" itself.

We have occasionally glanced at some of these corporations—at one of them (Gresham College) very recently. Is Gresham College the worst example we could have found? Oh no! The doings of the Gresham Committee are unblushingly paraded, and the City is determined to stand upon what it is pleased to call its "legal right" to the *dividends* upon the stock of its several component companies. Be it so;—the *legality* is yet to be tried. Nor is the day far off. The City however claims not only its *soi-disant* own dividends, but it claims the exercise of trust functions according to its own will and pleasure, quite independently of the plain intentions of the

founders of the several trusts. Of the recent election to *one* chair in that college, we have already spoken; and when we can find space for it, we shall report upon the manner in which the new Professor made his scientific *congé* to his scientific audience.

Our present business is with what one of our most able contemporaries calls the "scion of the Gresham House"—the *Royal Society*. We have known this Society so long, and been so intimately acquainted with the details of its management—so disgusted, moreover, with the low standard of morals that prevails in its councils, and so often shamed with the wrongs which it has done to scientific men—that we never think of it without pain, nor contemplate the manner in which it exercises its functions without a shudder! Charnel-house as it is, even "whitened" and plastered inches thick, it is offensive enough; but when the incumbents of the "apartments in Somerset-house" are dead even to "decency of appearance" in their corruption,—when they allow the aggregate ignominy of that corruption to remain unwashed, and even glory in their own depravity—it becomes a sight so sickening, that we are glad to turn our eyes away from the hideous vision, and avail ourselves of a snuff-box or a bandanna, or, indeed, of both. Has the public the same instinctive feeling? Why else is it that so many tobacconists and bandanna-dealers have fixed their "stores" along the river side of the Strand?

But, homely metaphors apart, we can only look upon the history of the Royal Society as a history of most iniquitous misdoings towards science and scientific men,—as a history that has no parallel in modern times, whether scientific, literary, ecclesiastical, or social.

"None but itself, itself can parallel."

We are fully aware of the awe with which the solitary student, the provincial oracle, and even the public generally, look upon the imposing array of eight hundred names which compose the list of Fellows of the Royal Society—many of them with whole lines of titles appended, and some with five or six such lines. Let such awestruck persons look a little farther, before they form a conclusion respecting the composition of the Society, and still more respecting its council and management. The scrutiny may be hereafter useful to them.

In the first place, it will be found that of these eight hundred, about one-half have not even the shadow of a pretence to the slightest knowledge of any one science whatever. Peers, members of Parliament, state functionaries, millionaires, country gentlemen, lawyers, and a sprinkling of Antiquarian Fellows and men of mere letters; these constitute full one-half the long list of Fellows. Nay, so anxious have the present and past Councils been to get such names on their list, that they have teased or tortured such men, even to persecution, to join the Society; and they have been met as men begging in aid of a charity would be received—by a reluctant consent, which the victimised amateur considered to be the toll he must pay on his road to popularity!

In the next place, there is a long array of *professional* names—chiefly medical men, somehow or other connected with the London hospitals, or the Universities and public schools; yet men who have either not added one single truth or discovery to the mere professions in which they are engaged, or at best, some trivial hand-book to their elementary literature. These constitute, probably, about one-half the remainder. These, indeed, are men who barely maintain a respectable *professional* reputation: free from gross charlatanism, yet innocent of pushing the human mind forward in its career, whether towards exaltation or debasement. They are simply good citizens, doing the ordinary duties of their positions in a jog-trot kind of way, but as little worthy to be called "men of science," beyond their own spheres, as an ingenious artizan or a nomadic "philosophical lecturer"—indeed, often far less so.

We thus dispose of about six hundred of the Fellows of the Royal Society very summarily; leaving we suppose little less than two hundred, who are, in some sense or other, men of science. We have, indeed, been sufficiently liberal in our allowance of numbers to this class; but in the midst of conscious abasement, we would not take the darkest possible view of our condition. Hence the number shall stand unreduced.

Of these men, the far greater part are professional—no disgrace assuredly. A

few are men of fortune, and a few are probably poor enough. The general pecuniary character, however, is that of competence — and a competence, too, realized by professional exertion. Such men deserve all honour.

Still even of these, a comparatively small number, are, in strictness, entitled to the character of *philosophers*. For the most part, both their recognised ability and their entire researches are altogether *professional*. The greater portion of their experiments and observations relate to mere details; and their reasonings are but deductions from more general and admitted principles. Their labours are, however, often of great use in respect of their own professions, and hence ultimately to society itself: but as a general rule, such labours are seldom of much real value to philosophy, and neither require nor imply a very high order of intellect. Born in another rank of society, they would have been ingenious mechanics or efficient corporals: but they would never have invented the steam-engine or have gained the Battle of Waterloo. They possess talent and ambition: but they have little original genius.

A few remain when the sifting is completed with the most rigid care—a few of whom their Fellows are not worthy, whom the world should delight to honour, and of whom the Royal Society should be proud. But does the Society honour them? Yes—on one condition, and on one only: viz., that they allow their names to be used as a sanction to the purposes of the Council, and not interfere in respect to the acts for which their names are put forth as a guarantee. These men's names are placed on Councils which they seldom attend; or if they do sometimes make their appearance at Somerset House, it is only to meet their friends pleasantly, and above all things avoid any inquiry which would lead to disagreeable discussions. They are made the decoy-ducks of the Council—and never suspect it, good, easy, well-meaning souls! They are often very indifferent even about their own affairs and interests: and it is very natural they should be still more careless about other people's. Would that these men could be induced to look at the other side of the shield which protects their popularity! Let them look at the treatment which men quite as eminent as themselves receive at the hands of the Council of the Royal Society: men whose only "weak point" is that their integrity is too strong to permit them to join in the moral sinuosities of this *imperium in imperio*—the venal and self-serving Councils! We could speak of specific evils in abundance: but wherefore the use of repeating that which is known, as it were, at the market-cross? Let those few (if there be that few) to whom this is new, only take the trouble of inquiring into the single case of Dr. Marshall Hall's treatment by the Royal Society; and then understand this to be a common sample of the treatment to which *independent and honest scientific men are there habitually subjected.*

"Why is this?" our readers will ask:—and we can only answer, so it is. We will, however, state a few facts in elucidation; and from these our readers must draw their own conclusions.

By its Charter (granted half in sport by that Royal Reprobate, whom his Courtiers designated by the title of the "Merry Monarch") the Royal Society has gained a *prèstige* with time. Many men of illustrious name have been enrolled amongst its members; and papers of incalculable value have been published in its *Philosophical Transactions.*

All this is unquestionable—nor would any honest man wish to question it, so much as to be proud of it. Yet look at the reverse: those papers,

> "Like angels' visits, few and far between,"

leave the chasms in the annual volumes filled up with a few mediocre productions, and an overwhelming mass of the most common-place "rigmarole" that ever was dignified (as if so dignified in sheer ridicule) with the name of PHILOSOPHICAL TRANSACTIONS. We have seen papers in this official production of the Royal Society that we should have blushed to see in our own pages. However, by parading the best as a sample of the worst, and by perpetually obtruding the learning, discoveries and genius of the Fellows of the Royal Society upon the public, the unthinking part have by degrees come to look upon F.R.S. as something pertaining almost to superhumanism:—pray, pardon a little Jonathanism, dear, good, courteous reader, for we are about no ordinary sub-

ject, and must be allowed a little verbal latitudinarianism.

Great men are seldom the first to discover the value of their discoveries, or even the power which character naturally gives them. Yet in the forest of the Lion-king, there prowls the hyena, there skulks the wolf, there crawls the serpent, and there stealthily skips the cunning ape from bough to bough. The very jackal is less the "lion's provider" than the lion's scavenger. The Royal Society is the strict type of the forest of the Royal brute.

Now, as science itself is one of the trades of a civilized community, it is embraced too often in the spirit of trade. Where there is one man capable of striking out an idea, there are hundreds capable of using it: where one man can educe a system out of chaos, there are thousands of mercenaries to turn it to their own pecuniary account. Fame, however, is the chief item of commerce at the Royal Society: and social influence the reward. A host of crafty intriguers creep about the skirts of the man of genius, deferentially attending his looks and bowing to his nod: meanwhile, to use an old phrase, "laughing in their sleeves," with the conviction that they shall ultimately appropriate to themselves the fame which he has earned, and the rewards which are his due. He is too busy in his researches to see their by-play, and too unselfish to think of his own reward.

It is of the class that *trade* in reputation for science—that are incapable of earning that of which they are so greedy—that are mole-eyed scientifically, though they be far-seeing enough as respects their own mercenary interests:—it is of these we say, that the active and acting portion of the Royal Society's Councils are too often constituted. They are men who in different grades of life might have distinguished themselves correlatively:—if in the law, they might have been "sharp practice" attorneys; if in trade, either bill-discounters or tallymen; if the "people," second-rate *chevaliers d'industrie*, or have figured in the purlieus of Leicester-square at *rouge-et-noir;* and if medical men, and *unconnected with the Royal Society*, manufacturers of a hundred rival nostrums to those of Doctors Eady and Holloway. As it is, they are gentlemen who claim to be of unquestionable honour; and so blindly are we expected to rely upon their honour, that we must not even canvass their motives, their science, their judgment, or their perfection in any sense! To hint a doubt is to be "factious:" to make a charge leads to complete scientific ostracism! The honour of the few scientific names—though of men who know no more of the doings and designs of the Council than "the medicine man" of a Red Indian tribe—is pledged for them; and an unthinking public accepts the pledge as a proof that nothing can be wrong in a body which includes members of such unquestioned scientific eminence.

Cannot our readers—the slowest and least suspicious of them—*now* see how it is possible for the *real* Royal Society to become as corrupt as the sewers of London are said to be? Can they frame any kind of reason why it should not necessarily become so? One thing, at least, is certain—that a little knot of persons, no one of whom has established the least claim to philosophical superiority, and many of whom are tainted with suspicious official doings, are the real and virtual governors of the Society's affairs. They decide upon who shall be admitted Fellows; what papers shall be printed in the "Transactions;" who shall be "rewarded" with the medals; and, in short, who shall be illustrious in science, and who contemptible! Their dictum, too, they tell us, is to govern the judgment of posterity, in the same way as contemporary opinion must bow before their wisdom!

Were the Royal Society what the public takes it for, and what it so sedulously holds itself out to be—*a body of honest, and learned, and philosophical men*, meeting at Somerset House, with no other objects than to discover truth, and encourage those who were extorting from nature her most recondite secrets—then, indeed, its existence would be an honour and a blessing to our age and country. Being, however, as it really is, the conclave of the intriguing, the unscientific, the selfish, and the suspected; being, moreover, the tomb in which many discoverers, of superlative merit, have been buried at their birth; and being many things else, which are incapable of adequate description:—we hold it to be, as now constituted, a public deception and a monster nuisance. The most offensive physical nuisance

would be a very imperfect metaphor for this great intellectual nuisance — this charnel-house of science!

Why, then, do we bring this subject forward? Simply this:—that publicity of an abuse must always precede its removal. Every abuse has its "vested interests;" and those who enjoy them will fight long and fiercely for their retention. The Royal Society functionaries are at present all-powerful; but their power is doomed, and another year may be its last. It is only by a dishonourable trick, unworthy alike of the scholar and the gentleman, that they maintain their hold upon power. They are, indeed, buttressed up by a section, the six hundred do-nothing noodles that sign themselves "F.R.S.;" but most of them do it on the conservative or drag-principle, without knowing the merits of the case, or further caring for the results, than as having complied with the importunate solicitations of the Council. Even Sir Robert Inglis (their chief supporter on a recent occasion, and a member of the present Council!) would, we are sure, *were he made acquainted with all the facts*, exercise as much of his "House of Commons'" dexterity to overthrow the Council as he did on that memorable occasion to support its acts.

Had the Reformers been as powerful in numbers as they are strong in scientific and in personal character, we should not now have had either to lament or condemn, in terms so strong, the present state of the Royal Society. To purify it for decent men, they have worse than scavengers' work to do; but, like Jordan Lynch, or Southwood Smith, they will dare a great deal for the good of society and the welfare of their great family of brethren, even though they fall victims to the social pestilence.

We have hitherto spoken of the "clique" of the Royal Society generally; and we regret that we cannot for want of space descend to the Royal Society in detail, specifying its particular members, and their especial characters. We do not, however, say all we know, lest their great lawyer, Mr. Archibald Stevens, should be "down upon us" in the Queen's Bench—for it may be new to some of our readers (though we hope to few) that "truth is a libel." Even the *chevalier d'industrie* may get his verdict and his "costs" if we interfere with him in his honourable and honest vocation! We shall, therefore, in deference to the wisdom of our ancestors (and of our cotemporaries too) rather leave a truth to be inferred than voluntarily incarcerate ourselves in the "Bench" for uttering it.

Our object, therefore, is to warn our readers against the penny-a-line and semi-official paragraphs which they will see in the daily and weekly papers (the *Globe* and the *Observer*, which are the especial organs of authority, with the *Times* and other morning papers) about the election which is to take place on the 30th inst. of the "President, Secretaries, and other members of the Council." Their names have been in print before us for more than a week; and we are quite deliberate in saying that a more infamous insult was never offered to the slaves on a South American plantation, than is offered by (what is called) the "House List" propounded by the present Council of the Royal Society for the composition of the next. Those who can swallow this list need not fear the Javan *bohon-upas*: they may beat an ostrich in swallowing tenpenny nails. It will, however, form an *experimentum crucis* of the Royal Society's stomach. The Society will once more degrade itself we have no doubt—but will it do so a second time, after the "trick" played upon it this year?

This capital piece of "jockeyism" must be briefly told. At the last anniversary Dr. Roget was certain to have been blackballed as secretary, for the share which he had had in the proceedings of former years: *and he knew it.* He made a rambling speech deprecatory of immediate dismissal, and promised to resign at the end of the present year, "if the Society would accept of his services till that period." He lauded his services of twenty years, as though they had been gratuitous, and spoke so feelingly of the "sacrifices" he had made for the sake of the Society, that a company of sensitive men (who feel more sensitive than sensible on such occasions) were fain to give him the year's grace he implored. The "House-List" then passed. In May the pert Marquis, who presides over the Society, finding that he, too, was little likely to pass the next ballot, made a speech (at an anniversary created for the occasion, as was becoming

for a patrician president,) in which, after a long string of truly "noble" platitudes (such as would even have become a Duke instead of a Marquis—a Howard instead of a Compton,) he intimated also his intention of retiring from his office. His chair had been an uneasy one for some time, and he sat in it somewhat after the manner of a parched pea on the head of a drum; and to prevent being tossed overboard he cried *peccavi!* It was now judged that not only the Marquis of Northampton and Dr. Roget would retire from all interference in the affairs of the Society, but that their partner in their alleged misdoings, Mr. Christie, would, to keep up at least the *character* of a gentleman, retire with them. Hopes were therefore entertained of some little cleansing of the foul sepulchre.

But what is the use of language? Is it, as somebody said (the saying is fathered upon Talleyrand, but unjustly,) "to conceal one's intentions?" At least, the Council of the Royal Society so uses it.

In the new "House-List" we have still the old hack-names. We have here, *again*, the Marquis of Northampton, Dr. Roget, and Mr. Christie: the last as Senior Secretary, and the two former as Councillors! We are in the position of the little French tailor—"*Gar! Monsieur Tonson come again!*" Yes, and Monsieur Tonson will come again and again, if we do not set the intellectual police of the Society to "dog his steps," and seize him in the act. Here the Marquis sets up a puppet in the untarnished name of the Earl of Rosse, whilst he himself works the presidential wires; and Dr. Roget replaces himself by a person more remarkable for his *ingenuity* in pleading a bad cause than for *ingenuousness* in seeking the true and the beautiful and the honest in science. The retiring officers cast off the responsibility, but retain the powerful influence of their vacated posts. Call ye *this* reform? Is this your intellectual *sanatory* act? Is it even a *sane* act to submit to such a wanton insult as well as deep wrong? What a glorious government is that of the Royal Society—and how proud should its Fellows be of the appendage "F.R.S." to their several names! Is it not the badge of ignominy—the yoke on the neck—the shackles on the leg of the ignoble slave?

Yet the "good times are coming," and we shall still see the Society renovated. Truth and honour will ultimately, if slowly, prevail. Let every Fellow, whose sense of honour is not opiated, make his appearance at Somerset House one 30th of November after another, and, by his vote on the successive lists, at least record that there is one man not totally devoid of every feeling of honour, truth, or shame. He must console himself with the idea, that if the House-List be carried this time (which, dexterous as the Council has been, we are by no means prepared to say it certainly will be), it will only be disgraceful to the nominating and the electing councils on account of their tergiversation; but if it be carried hereafter, the disgrace will fall upon the Fellows, whose apathy or selfishness should allow it to be carried. At present, all we can say is, that honest men have been "outwitted." Still it will hereafter be their own faults if they be duped, at least in this fashion. Let them fight on:—*le bon temps viendra.*

Let us, in conclusion, just take a parallel. An injured and indignant people drive the corrupt ministry of a corrupt king from office; and with a *demand* for a reformation not only of the administration, but of the constitution. The ministry is *re-formed* by putting an unknown puppet as First Lord of the Treasury, the late first Lord taking the Home department: and the Foreign Minister exchanging places with the Chancellor of the Exchequer: all the other offices being either filled up by the retiring ministers, or by their professed parliamentary supporters "through thick and thin." Would any man of sane mind call this a *reformation* of the cabinet? Or can any people exist, so besotted in ignorance, as to accept such a reform as an answer to their demands? Yet this is exactly a parallel to the reform which the Fellows of the Royal Society have obtained.

They may accept such a "reform," if they like to consider it so. It is their business, and not ours. It is our business, however, to disabuse the public mind as to the character, composition, and scientific authority of this Society; and this we shall do from time to time, as occasion offers itself.

The chair of Newton! How few have pressed it worthily! Will it ever be again?

The foul worm feeds upon the carrion of the dead lion; and the sepulchre is no longer even whited without. The Royal Society is, truly, the charnel-house of Science.

IMPROVED SAFETY VALVES. BY ALFRED GREGORY, ESQ., C. E.

Fig. 1.

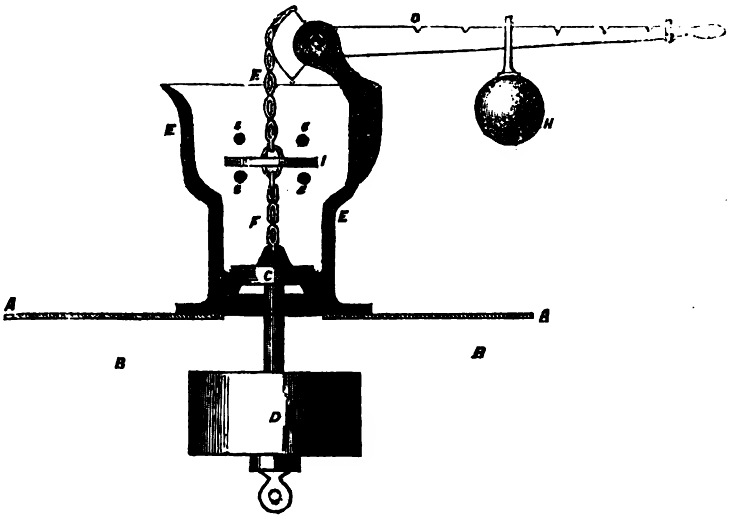
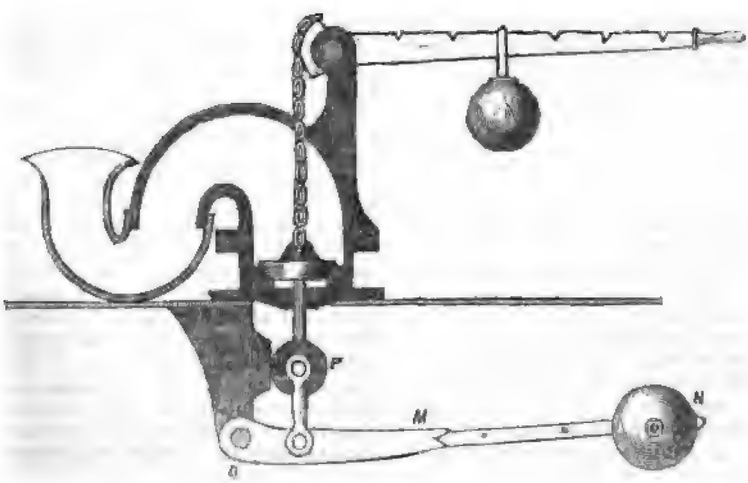


Fig. 2.



Sir,—I have an invented an improved form of safety valve for steam-boilers, which has met with the approbation of several eminent engineers. I am desirous of giving it publicity, and for that purpose respectfully submit the accompanying sketches and description for insertion in an early Number of the *Mech. Mag.*

The advantages do not require to be

much insisted on. The practice of overloading the safety-valve is much more common than is generally supposed: sometimes it is the act of *ignorance*, but most frequently that of *will*, not only endangering life, but injuring the *pocket* also, in the destruction (which is very serious) that ensues to the *boilers*, *fire-boxes*, &c. The number of fines levied on locomotive enginemen furnishes sufficient evidence of the frequency of its occurrence.

Description.

Fig. 1, represents the safety-valve in a form appropriate for stationary use.

Fig. 2, another modification, on the same principle applicable to boilers of every description, locomotive, marine, and stationary.

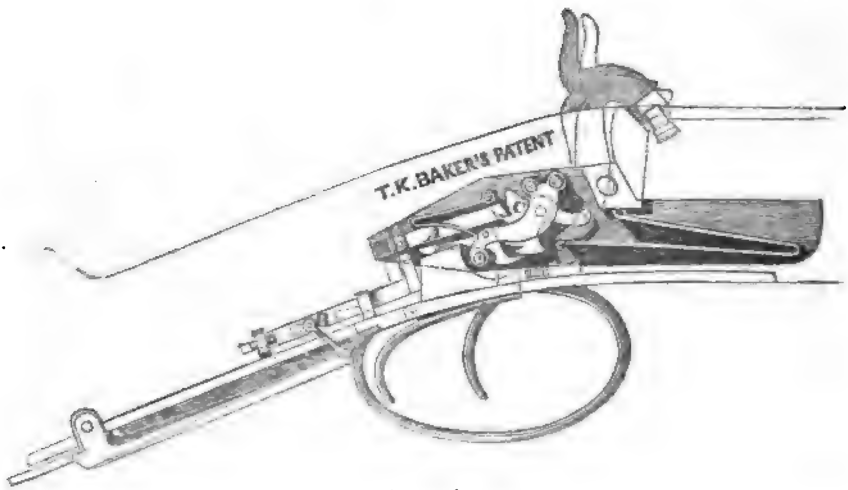
Fig. 1, AA, represent the top plates of boiler; BB, the steam space inside; C, the ordinary conical valve, having a perpendicular spindle, to which a weight, D, is attached; EE, valve-box; FF, a chain, which is connected to the valve at one end, and at its other end to the short curved part of the lever, G; H is a regulating weight; I, a shield to protect the valve from injury or interference; *l*, *l*, *l*, *l*, four bars or stops to the shield I, for frustrating any attempt to damage the valve.

The mode of working is, for the steam to raise the valve, as usual, when its pressure exceeds that of the weight, D, less the lifting power of the lever, G, and weight, H. The weight, D, being inside the boiler, cannot be for any mischievous purpose got at; and it is equal to the *extreme* pressure allowed upon the boiler, or may be made so, by hanging weights to the eye-loop of D, which additional weights may be reduced, or altogether removed, as the boiler deteriorates by wear. For any *less* pressure, according to the working necessities of the engine, the engineer has the same control over the valve as at present, by sliding the weight, H, on the lever, G, which operates in taking off weight, *regulating the reduction* as he pleases; but he cannot increase the load upon the valve beyond what the weight, D, inside the boiler, gives; for, if hanging more weight on the lever, G, he takes off, instead of increasing pressure; and, on the other hand, if raising the handle end of the lever, it has no effect upon the valve, on account of the connecting medium being *a chain*, which, of course, can only operate in one way, hanging loose, as it does, and throwing no stress upon the valve when moving downwards.

Fig. 2 is another form, involving the same action, but instead of the heavy weight attached to the valve-spindle, as before, there is, inside the boiler, a lever, M, having a weight, N, and fulcrum at O, equal in its effect to the extreme pressure allowed, and which may be reduced as the boiler, by use, weakens, by fixing the weight, N, nearer the fulcrum, convenience for which is shown. Instead, also, of the protecting shield, as in No. 1, the blow-away steam is here carried off by a double U-bent pipe, the accessible half of which is made of thin sheet copper, strong enough to carry away the steam as it blows freely into the air, there being then little or no pressure; but if the steam be confined within it, through any wilful attempt to plug the pipe up, the copper will *rend* (a result peculiar to that metal); and permit the necessary escape. There is likewise shown a small roller P, to counteract the curvilineal action of the lever, M, and keep the valve-spindle from "sticking." But both this and the copper pipe are precautions no more necessary than at present with the best constructed valves, and might safely be dispensed with. The remaining parts and action of figure 2 are the same as figure 1.

Both plans represent the principle of a valve (the mechanical arrangement of which, however modified) embraces every advantage, as to security, of a "*locked valve*," in frustrating any attempt to overload it, either by accident or design, through ignorance or will, without the usual attendant disadvantages of inconvenience, expense, &c., of a second valve, and liability to "*stick*" by corrosion of parts through *standing long unused*, &c.—a liability which the present form has not, as it is the engineers' *frequent*-"*working*" safety-valve, which is a *locked* and limited one, but possessing all the facility of regulating his pressure that he has now, though not allowed to exceed the fixed *extreme* safe point.

BAKER'S SAFETY GUN-LOCK.



Sir,—In your valuable publication of the 11th inst., there is a letter signed Θεωνδωρον, and headed "Safety Gun-Lock," in which the writer questions the novelty of an invention patented by me prior to his publication of that he now sets forth as having been a new idea of his own in 1845. I should not have thought of intruding myself in your columns, but it appears to me an act of justice to your readers and the public that they should be convinced that your correspondent is in error, both as to his gun-lock being a *safety* one, and as to the idea of securing or bolting the trigger having been new in 1845. The side pressure of the thumb to relieve the trigger may be new, at the same time very inconvenient to get accustomed to. Other methods of relieving the secured triggers have been applied by gun-makers—more numerous than I can describe—for the past twenty years. Again, I must observe, that your correspondent's invention (if it is new) has nothing to do with the title of a "Safety Gun-Lock," which is the machinery that causes the gun to explode,—the trigger being only the lever acting on that machinery. My triggers are at the same liberty as in all guns usually made, and from the tumbler of the lock being secured in all positions where accidents are liable to occur, must not be put in comparison with the triggers being fixed, which can only be of use on the full cock. That your readers and the public may distinctly see the difference of our claims, I enclose a diagram of my invention, and by inserting this explanation in your museum of information you will oblige

In the figure, A represents the safety-bolt, which is propelled by the lever of the guard, B, into the tumbler, C, as soon as the cock is raised from the nipple, as well as on the full cock.

Yours, &c.,

THOMAS K. BAKER.

84, St. James-street, Nov. 18, 1848.

REPLY TO "RATIO" ON THE "NOTE" TO SIR HOWARD DOUGLAS'S "PROTEST."

Sir,—The writer of the paper signed "Ratio" (page 469), has there put himself in a very doubtful position: he has shown, either that he cannot recognize a fluent or integral when it is before him, or that he wilfully closes his eyes to the truth. If he were able or willing to follow the investigation referred to (page 446) in "Hutton's Tracts," he would perceive that the "partial resistances" are completely integrated; and that, as a corollary to the general proposition, the resistance to a plane surface of a given height varies as the square of the sine of the inclination: the like "inability" or "attempt at mystification," exists in the references to "Moseley's Hydronamics" and to "Ramsay's Hut-

ton," where a resistance varying with the cube of the sine of the inclination is given as the general law for bodies presenting curve surfaces to the direction of the pressure of the fluid, in which bodies the number of particles acting upon the different elementary frustums, instead of being constant, as in the case of breakwaters, or the piers of bridges with plane surfaces, vary with the sine of their inclination.

The last paragraph on page 469 (*ante*) contains a remark on a passage which is said to be in the note to Art. 2 of Sir Howard Douglas's "Protest." The passage, as quoted, is as follows:—"The law of resistance developed in terms of the sine of inclination, which is shown by mathematicians to obtain in the case of an element of the fluid, is that which obtains for the whole resistance upon the plane." It is designated an *inadvertent assertion*, and a *lapsus*, but no such passage exists in any part of the "Protest" referred to.

In one respect, "Ratio" is right: he observes, that "it is not unworthy the exercise of his (the "Old Engineer's") judgment whether he is likely to add to his reputation by prolonging the discussion of this subject." I wrote, thinking there was a chance that the truth might be felt; but what impression can be made upon a mind which receives the absurdity that a *constant* can be expanded in terms of a *variable* (p. 469, col. 1), and which rejects the fact that a fraction whose numerator is equal to its denominator (p. 446, col. 2) is equivalent to unity? For this is implied in not admitting that, by the variability of AB, ϕ vanishes from the equation $n = AB \sin. \phi$. I am, Sir, yours, &c.,

AN OLD ENGINEER.

DAVIES'S PATENT ROTARY ENGINE, STEAM-PROOF METALLIC PACKING, ETC.

(Concluded from page 484.)

Mr. Davies's mode of working the expansion valves is new and ingenious. The object, of course, sought to be obtained, is celerity of action; and this, we think, is very effectually accomplished. The expansion valves are contained, as before mentioned, in the chamber. M^a. The apparatus for working them consists of a combination of parallel levers, with a double-acting cam motion, of the same kind as that used for working the sliding stops, before described. Figs. 19 and 20 exhibit the principal portions of this apparatus on an enlarged scale; fig. 19 is a side elevation on the line *ab* of fig. 20 (see also fig. 3, *ante*, p. 433). Fig. 20 is an end view, with the front plates, B^a and C^a, removed.

B^aB^a are connecting plates surrounding the shaft, A, and enclosing a pair of friction rollers, D^a and E^a, which revolve on the peripheries of the cams, I^a and K^a, the curves of which are similar to those of the cams, C^aC^b, and obtained in the same way. J^a is an axle attached to the standard, X, on which is fitted a bell-cranked lever, N^a.

The length of the straight arm of this lever is equal to the length of a line drawn between the centre of the friction rollers; and it is bisected by the axle, J^a. The points in which O^a and P^a are fixed, are exactly in the centres of the levers, C^aC^a. The extremities of the straight arm of the bell-crank lever, previously mentioned, are connected by the pins, O^a and P^a, to the levers, C^a and C^a. Similarly, also, the link, Q^a, is connected by the pins, R^aS^a, to the lower extremities of the levers, C^aC^a. The link, Q^a, is of the same length as the straight arm of the bell-crank lever, and, consequently, of the same length as a line joining the centres of the friction rollers. It follows that the levers, C^a and C^a, and the bell-crank lever, N^a, and the link, Q^a, will form a parallel frame, free to move round the joints, O^a, P^a, R^a, S^a, and dependent for support on the fixed axle, J^a. It follows, also, that whatever may be the relative positions of each opposite pair of levers, the parallelism cannot in any degree be affected. As the engine is a double-acting one, each cam has two projections, as has already been explained. Therefore, during each revolution, the friction rollers are twice thrown through a space equal to the eccentricity of the cam. It will, therefore, be evident that the levers, C^aC^a, work round the central fulcra, O^a and P^a, and that any motion of the friction rollers would equally turn the other extremities of the levers, C^aC^a. So that when, by the rotation of the cams, the friction rollers assume the positions indicated by the dotted lines, the opposite extremities of the levers, C^aC^a, must also assume the positions similarly indicated. The throw of the cams, and the working of this parallel system of levers, correspond with the admission of steam into the cylinder, B, and the motion of the stops, F^aF^a.

To communicate the motion to the valve within the chamber, M^a, there is a connect-

19.

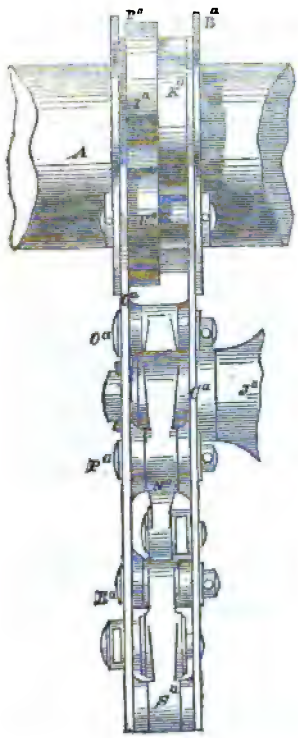
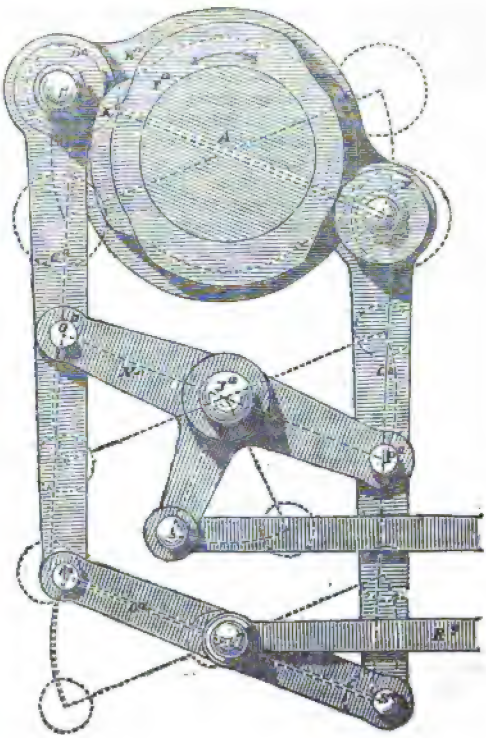


Fig. 20.



ing rod, R^g, one end of which is fixed by a pin, round which it is free to move as far as the centre of the link, Q^a, and the other end is attached to the way-shaft, U^a. T^a is a lever, worked from the way-shaft, through the medium of the vertical and longitudinal levers, Y^a. X^a is a fulcrum, about which the lever, T^a, turns; A^bA^b are links, attached at equal distances, one on each side of the fulcrum, X^a, and communicating directly with the expansion valve by means of the rod, N^b.

The mode of working the slide is thus easily traced. But for the purpose of working expansively and regulating the degree of expansion according to the will of the attendant engineer, there is a handle, H^g, which works the depending arm of the bell-crank lever, N^a, through the medium of the connecting-rod, I^g. According to the obliquity or horizontal position of the straight arm of this lever, will depend the position of the friction-rollers with respect to both cams. Another and fixed position of the friction rollers will regulate the lead of the expansion valve in reference to the slide valve or stop, F^a. For it is evident that if the friction rollers be placed by the bell-crank lever in the position indicated by the dotted lines, fig. 20, the throw of the cams will come into action, and the expansion valve in the chamber, M^a, will be acted on earlier than the stop, F^a, in the chamber, G^a.

Mr. Davies concludes with pointing out those parts of his invention which are applicable to other purposes than rotary engines.

First among these is my metallic packing, which is applicable not only to the shafts of rotary engines, on my own plans of construction, but to all other rotary engines, in which shafts are used and may be also usefully applied to horizontal shafting of every description, especially such as is ordinarily used in marine screw propelling, in air engines, and in blowing machines. It may be used too with vertical shafts, though perhaps with less advantage.

Secondly. The mode I have adopted in my rotary engines of connecting the working shaft with the piston, whereby the shaft is left free to slide through the piston while the piston is kept constantly in the same plane of rotation, is equally applicable to all other rotary engines where the shaft and piston are directly connected together, and the injurious effects of end pressure on the shaft are desired to be avoided. *Thirdly.* The peculiar combination of parallel levers with a double acting cam motion, which I make use of to impart a quick motion to the expansion valves of my improved rotary engine as before described, is also applicable to working expansively reciprocating steam engines of all kinds, and with this twofold advantage, that it admits of the valves being so placed as to be always in advance of the piston in whichever direction it moves, while the engine is at work, and enables the amount of expansion to be graduated by a single movement of a lever or screw. And, *Fourthly*, the peculiar curved form which I give to the gabs of locomotive carriages when fitted with my rotary engines, whereby any undue strain on the connecting rods is avoided, may be also advantageously applied to other rotary engines, as also to reciprocating engines.

HORÆ ALGEBRAICÆ. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

(Continued from p. 367.)*

IX. SURD EQUATIONS.

Leaving for the present the subject of the New Algebra, I shall recur to that of congeneric surd equations. And, first, I shall give a notation devised by HORNER,† and, if I recollect right, adopted by Dr. PEACOCK,‡ for expressing these equations by appropriate descriptions.

Let the product of the m congeneric surd formulæ

$$f_1, f_2, .., f_m,$$

be

$$F_n,$$

where

$$F_n = 0 \ldots\ldots\ldots\ldots\ldots (1.)$$

denotes the algebraic equation of the nth degree put under the usual form; then, f_r being one of the m congeneric formulæ, the equation

$$f_r = 0 \ldots\ldots\ldots\ldots (2.)$$

is said to be an equation of the degree,

$$\frac{n}{m};$$

it being understood that the functions f do not involve negative powers of the unknown quantity involved in (1.)

We have already* seen that no such equation as (2.) can be satisfied by any other quantity than a root of (1.). And we easily infer that, if any one of the equations,

$$f_1 = 0, f_2 = 0, .\,, f_m = 0,$$

do not admit of solution by means of any of the roots of (1.), then that that equation has no root whatever, and is in fact an impossible equation. I shall not attempt in this place to give a general discussion of congeneric surd equations, but shall confine myself to the subject of congenerics of the degree,

$$\frac{2}{2},$$

of which I have considered particular instances in previous volumes of the *Mechanics Magazine*.†

Let

$$y = px^2 + qx + r,$$

and

$$z = p'x^2 + q'x + r',$$

then the most general form under which a congeneric surd equation of the degree 2 : 2 can be exhibited is,—

$$\sqrt{y} + \sqrt{z} = 0 \ldots\ldots\ldots (3.)$$

and its congener may be represented by,—

$$\sqrt{y} - \sqrt{z} = 0 \ldots\ldots\ldots (4.)$$

whence, multiplying (3.) and (4.) we obtain

$$y - z = 0 \ldots\ldots\ldots (5.)$$

the equation (5.) being equivalent to

$$(p-p')x^2 + (q-q')x + r - r' = 0,$$

of which last equation let x_1 and x_2 be the roots.

Let y_1 and y_2 be what y becomes when, in the expression for the latter quantity, we write x_1 and x_2 respectively in place of x; let z_1 and z_2 have a similar meaning in relation to z; then we are now about to endeavour to ascertain *à priori* which of the following equations, viz.:—

* This paper should have appeared much sooner, but was unfortunately mislaid.—ED. M. M.

† See *Phil. Mag.*, s. iii., vol. viii., pp. 49—50.

‡ I think in an Examination for Smith's Prizes.

* *Mech. Mag.*, vol. xlviii., p. 181.

† See vol. xlvii., pp. 14, 135—6, 151, 331—2, 409—410, and vol. xlviii., pp. 181—183.

$$\left.\begin{aligned}\sqrt{y_1}+\sqrt{z_1}&=0\ldots.(6.)\\ \sqrt{y_2}+\sqrt{z_2}&=0\ldots.(7.)\\ \sqrt{y_1}-\sqrt{z_1}&=0\ldots.(8.)\\ \sqrt{y_2}-\sqrt{z_2}&=0\ldots.(9.)\end{aligned}\right\}(a)$$

are true; it being premised that in general* only two of them hold simultaneously.

In what follows, I shall adopt an assumption which I have before† made, and shall suppose that the formula

$$\sqrt{(+r)^2 \pm (-s)^2}$$

is to be affected with the positive sign when r is greater than s, and with the negative sign when r is less than s.

Now, since in the equation is marked (a) the first radical is supposed to be taken positively those four equations are all included in the following:—

$$\sqrt{y}(1 \pm \sqrt{u})=0,$$

where, $uy=z$;
hence, since y is in general different from zero, we may confine our attention to four new equations, in which we, of course, suppose that

$$u_1\,y_1=z_1 \text{ and } u_2\,y_2=z_2.$$

The new equations are

$$\left.\begin{aligned}1+\sqrt{u_1}&=0\ldots\ldots(10.)\\ 1+\sqrt{u_2}&=0\ldots\ldots(11.)\\ 1-\sqrt{u_1}&=0\ldots\ldots(12.)\\ 1-\sqrt{u_2}&=0\ldots\ldots(13.)\end{aligned}\right\}(b)$$

and the questions to be decided are, (1.) Which of these hold good in any particular case? and (2.) *Why* in general only two of these equations (b) can be satisfied.

A simple substitution of x_1 and x_2 in the equations (b) would at once enable us to determine the first point, but would in no degree aid us in finding an answer to the second question: the latter can only be answered by examining the symbols which enter into the constitution of the expression u. I shall give a short sketch of the principles which I think ought to guide us in such investigations, and shall afterwards apply them to an example or two. I may add, that in answering the second question, it will be found that the first is answered also.

In all congeneric surd equations of the degree 2 : 2, either the numerator of u, or its denominator, or both, will be reducible to the form of a sum or difference of two squares; further, it will be found that such reduction will in all cases enable us to put u under one of the following forms, viz.:—

$$u=v\,(+1)^2, \text{ or, } u=v\,(-1)^2;$$

and lastly, all ambiguity is thus removed as to the sign to be attached to $\sqrt{u}$; for we must give that root the positive sign when u is of the first form, and the negative sign when u is of the latter form. And to give that root a double sign, would be to violate our symbolical conventions, and to involve us in inconsistency and error. Were any authority necessary to be cited in favour of the *symbolical* distinction between $(+1)^2$ and $(-1)^2$, I should content myself with referring to Dr. PEACOCK's writings.

Still keeping in mind this rule of symbolical evolution, let

$$u_1=v_1\,(+1)^2. \text{ and } u_2=v_2\,(+1)^2,,$$

then, in this case, the equations (12.) and (13.) may be satisfied—but not in general (10.) or (11.)* We have no right to infer that the latter equations have any solution, for the symbolical conditions do not indicate any; and, in fact, it would not be difficult to show, that in general when (10.) and (11.) are solvible, (12.) and (13.) are insolvible, and *vice versâ*.† I may here notice that all the quantities represented in this paper by v (with or without a suffix) are considered independently of any symbolical affection; that affection is expressed by the multiplier $[(+1)^2$ or $(-1)^2]$ which follows the v.

Again, let

$$u_1=v_1\,(+1)^2, \text{ and } u_2=v_2\,(-1)^2,$$

then in this case (12.) and (11.) are the two equations of which x_1 and x_2 are the respective solutions.

So, if

$$u_1=v_1\,(-1)^2, \text{ and } u_2=v_2\,(+1)^2,$$

the equations (10.) and (13.) are solved by x_1 and x_2 respectively.

Lastly, let

$$u_1=v_1\,(-1)^2 \text{ and } u_2=v_2\,(-1)^2;$$

* There are particular cases—those in which the equations $y=0$, and $z=0$ have a common root, (or roots,)—when three, (or all), of the equations (6.), (7.), (8.), and (9.) hold simultaneously.

† *Mech. Mag.*, vol. xlvi., p. 491.

* Otherwise, the sum of two positive quantities would be zero, and the same argument must be applied in the subsequent cases.

† *Vide Hor.* viii. [*Supra*, pp. 364—7]. Consult also *Mech. Mag.*, vol. xlvii., pp. 151, 331, and 409—410; and vol. xlviii., p. 181.

then the equation (10.) and (11.) are those respectively solved by x_1 and x_2.

The same inferences may be drawn with regard to (6.), (7.), (8.), and (9.), as to (10.), (11.), (12.), (13.), respectively. As to the particular cases in which *three* or *all* of the equations (a) can be satisfied see a note (* p. 519) to this paper, *et vide supra*, p. 367.*

As an example of the principle just laid down let us consider the cogenerics,†—

$$x-8\pm\sqrt{5x+10}=0, \ \ldots \ (14.)$$

which, when reduced to the forms of (3.) and (4.) become

$$\sqrt{(x-8)^2}\pm\sqrt{5x+10}=0;$$

then, $x_1=18$, $x_2=3$ and the relation

$$u=\frac{5x+10}{(x-8)^2},$$

gives

$$u_1=\frac{100}{100\,(+1)^2}=(+1)^2$$

$$u_2=\frac{25}{25(-1)^2}=(-1)^2$$

hence the value $x=18$ solves (14.) when the radical is taken negatively, and the value $x=3$ solves (14.) when the radical is taken positively.

Again, let‡

$$2x-5\pm\sqrt{x^2-7}=0\ \ldots.\ (15.)$$

Here, proceeding as before,

$$u_1=\frac{16(+1)^2-7}{9\,(+1)^2}$$

$$=\frac{(+1)^2}{(+1)^2}=(+1)^2,$$

and

$$u_2=\frac{(2\tfrac{1}{2})^2(+1)^2-7}{(\tfrac{1}{2})^2\,(+1)^2},$$

which we, as in the case of u_1, infer to be equal to $(+1)^2$; hence, both the values of x belong to the equation

$$2x-5-\sqrt{x^2-7}=0$$

and its congener is insoluble.

It is to be observed, that v being unity in all cases, u is in all cases equal to $(+1)^2$ or to $(-1)^2$.

In both the above examples y is a perfect square, but the procedure is applicable to all cases. Thus, if we had

$$y=x^2-4x-1$$
$$=(x-2)^2-(-2)^2-1$$
$$=(x-2)^2-5(-1)^2,$$

we should have no difficulty in assigning its symbolical affection if we adopted the rule laid down in a previous portion of this paper,* or the following one which is somewhat more direct, viz., that

$$\pm(+r)^2\pm(-s)^2\ \ldots.\ (16.)$$

is of the form $a\,(+1)^2$ or $a\,(-1\ \ )$ as r is greater or less than s, and that this *form* is determined quite irrespective of the *sign* which we prefix to the members of the expression (16.) This principle has, in fact, been employed in the investigation of the two examples and in that of the last form of y.

It now remains to confirm the accuracy of the proposition affirmed at page 182 of vol. xlviii. of the *Mechanics' Magazine*. That proposition only referred to the limited case in which y (or z) is a perfect algebraic square, but we shall see that its results are coincident with those given by this paper, for, when x_1 and x_2 are real and positive, the equations

$$cx-d+\sqrt{z}=0\ \ldots\ldots..\ (17.)$$

$$cx-d-\sqrt{z}=0\ \ldots\ldots..\ (18.)$$

can, in general, only be satisfied when

$$cx_1-d, \text{ and } cx_2-d,$$

have different signs. If we express this same condition in the terms that

$$c^2x_1^2-d^2 \text{ and } c_1^2x_2^2-d^2$$

must have different signs in order that (17.) and (18.) may be satisfied, we have the criterion given at the page last cited. It is not difficult to see that d is essentially preceded by the negative sign, and that if the successive results of the substitution of x_1 and x_2 in $cx-d$ be negative and positive respectively, then x_1 solves (17), and x_2 solves (18); but if these results be positive and negative respectively, then x_1 solves (18), and x_2 solves (17.). If both these results be negative, then x_1 and x_2 solve (17.), but not (18); and if they be both positive,

* It is only to-day that I have received proof slips of this paper, consequently, beyond filling up one or two pagings to VIII. of the *Horæ* (which was published since the present paper was written and transmitted to this Journal) I can do no more than express my high sense of the courtesy displayed in Professor YOUNG's communication at pp. 463—4 of the current (xlixth) volume of the *Mechanics' Magazine*.—*Temple*, Nov. 22, 1848.

† See *Mech. Mag.*, vol. xlvii., p. 135 (and 332), and p. 410; vol. xlviii., p. 182, col. 2, equation (7).

‡ See *Mech. Mag.* vol. xlvii., p. 331; vol. xlviii., pp. 182—183.

* And in the *Mechanics' Magazine*, vol. xlvi., p. 491. In such cases the square root is not ambiguous unless $r=s$. As to the representation of an ambigous square root. *Vide Hor.* VIII. [*supra* p. 366, col. 1, lines 24 to 31.]

then (18.) is solved by both x_1 and x_2, but (17.) by neither.

With the above remarks on equations of the degree 2 : 2 the present discussion of congeneric surd equations will terminate. I look forward to resuming the subject in some other place, but I think that to consider it further here would be foreign to the objects and purpose of the *Mechanics' Magazine*. I think that I have laid the foundation of a General Theory of Surd Equations, and I hope that these investigations will not prove to be barren of results. At any rate, I trust that any efforts, however humble, to throw a light on an anomalous—perhaps I may say mysterious—difficulty in algebra will be regarded with toleration, if not with indulgence.

Great Oakley, near Harwich, Essex,
October 2, 1848.

Corrections to vol. xlvii. of the *Mech. Mag.* P. 331, col. 2, note (*gg*); *after* expressed, *add* in a similar case.

IMPROVEMENTS IN COMPASSES — BUSH'S PATENT.

Sir,—In the *Times* of the 16th inst., under the head of "Naval Intelligence, Portsmouth, Nov. 15th," appears the following announcement:—

"A new invention, by retired Captain Sir Samuel Brown, K.H., patentee of the chain cables and numerous other improvements in ironwork, was exhibited yesterday in the dockyard, by the inventor, to the Hon. Sir Bladen Capel, K.C.B., Commander-in-Chief, the Admiral-Superintendent, and several other naval and scientific gentlemen It is a compass in a glass box, sustained by a small pillar with telescopic slides, by which it can be elevated or lowered to any desired height. *It is designed to obviate the local attraction of the ships.* The card is transparent, and the whole apparatus will supersede the use of the binacle. There is a mirror attached to it on which the helmsman will be able to see the reflection of the compass-card. A lamp will be placed over it at night. The whole is a most ingenious contrivance, and, if successful, will effect a great desideratum for the nautical world."

Now I think it highly probable that the writer of this notice has not known, or else has overlooked, the most important part of the matter; because it is pretty well known that merely inclosing a compass in a *glass box*, or even supporting it upon a *telescopic pillar*, will do mighty little in the way of "obviating the local attraction of the ship."

Possibly there was more than met the eye in the "small pillar," the contents of which might be such, as in some measure to possess the property in question. The best compass I am acquainted with (Bush's Patent), has "*a pillar*" containing an arrangement of magnets, so disposed as to cause a current of magnetic fluid to circulate with such energy that "the local attraction consequent on their being quantities of iron and other causes acting near the compass, is caused to be centralized in or near the axis of motion of the needle, whereby the needle of a compass is less prejudicially influenced, and will consequently act with more correctness, and, in fact, will be more similar in its performance and pointing to what would be the case were there no iron or other causes of attraction in the locality in which a compass may be placed." In Mr. Bush's compass, too, the needle is so nicely balanced—the points, caps, and supports all so accurately adjusted—that nothing can well exceed the truth and delicacy of the movements of this instrument. Very numerous trials have been made with Mr. Bush's compasses under almost every possible variety of circumstances, and with unvarying success. While the best Government and other compasses have been sensibly affected by the presence of large masses of chain cables, shots, &c., placed in proximity to them, the compasses of Mr. Bush (although the most delicate) have been wholly uninfluenced by the local attraction. Had the Portsmouth correspondent of the *Times* been acquainted with the proved capabilities of Mr. Bush's "ingenious contrivance," and the successful experiments which have been made therewith, he would have been obliged to admit that a compass adapted to counteract the prejudicial effects of local attraction is not *quite* such a "desideratum in the nautical world" as he had supposed.

It may be asked why an invention of such vast importance as this, calculated to avert an enormous loss of life and property—if proved to possess the advantages ascribed to it—has not been universally adopted?

In merchant vessels, a parsimonious economy in fitting out, limits the supply of every necessary to the CHEAPEST. No matter how sure the *future advantages*, with but few exceptions the

present cost rules all. This false economy is part and parcel of the "ship-sinking system," which is said to cost Great Britain "a ship and a half per day," and which has been the subject of severe and frequent comment in your pages.

In the Government service, private personal interests conspire with official prejudices and *vis inertia*, to exclude "MERE MERIT;" and he must be a very ignorant man, or a very bold one, who would venture (unaided by powerful patronage) to enter the lists with such formidable antagonists. It might be supposed that the laws of matter had but little connection with, or were by no means subject to, the influences of political factions; and yet we continually find that the most important improvements in chemistry, in mechanics, in hydrostatics, become *valuable*, or *valueless*, as the Whig or Tory factions push each other from their stools!

Mr. Bush, although a most ingenious man, is, I believe, but a civilian.

I remain, Sir, yours, &c.,
WM. BADDELEY.

29, Alfred-street, Islington, Nov. 17, 1848.

ON MR. STAITE'S ELECTRIC LIGHT. BY PROFESSOR MURRAY.

Sir,—It is impossible, in my opinion, to appreciate too highly Mr. Staite's electric light. It is brilliant in more senses than one, and is without a rival in any artificial light whatever, because, if I mistake not, it is identical in its nature and properties with the "blaze of day." Its varied application is as great as is the *éclat* of its unrivalled beauty; and none may calculate its extent and value in the economy of life. It seems to me without a figure, to be the *luminous* achievement of the age; and, if it can be developed and sustained at a moderate cost, it will cast into shadow every other light, from whatever source derived. I cannot well be mistaken in my estimate of its intrinsic value. I have always considered the electro light the *purest* light, as well as the *most powerful*, that can by possibility be obtained. It has been the subject with me of oft-repeated research; and I have from my numerous and frequently varied experiments, in former years, maintained the opinion as the offspring of conviction, and founded, as I think, on induction, of its *identity* with solar light. The light is entirely independent of the ambient medium, and effects no chemical change on its condition; therefore, no deterioration of the air can supervene from its use. I have sustained it in media of water, alcohol, ether, sulphuret of carbon, &c., and in gaseous atmospheres of carbonic acid, hydrogene, and nitrogene; the *density* of the medium will alone affect the brillancy of this light. By the interposition of a prism, I have obtained a spectrum, as beautiful as that of the "bow in the cloud;" and though it could not then be sustained of sufficient duration to communicate *magnetism* to a steel bar, and thus realise the experiments made by Mornichini and Somerville with the *solar* spectrum (the only link wanting to complete the evidence of their identity) nevertheless of its *actinism*, I had sufficient proof in its chemical effects, such as blackening "horn silver," and in the formation of hydrochlorine gas, by promoting the combination of hydrogen and chlorine. Its peerless purity and brilliancy—its safety (for if the charcoal be perfectly pure, there can be no *flame*)—its intensity and power, and being under entire control, are all of them attributes, recommendatory of its adoption in the economy of social and civil life, and prove that it must eventually supersede gas and other sources of illumination.

Even the Drummond light, apart from the circumstance of its being unmanageable, and altogether unfitted for the circumstances of ordinary life, must wane before the electro *light*, and cast a shadow in its superior effulgence. The oxyhydrogen light, stationed among the mountains of Morne, was visible at a distance of nearly 100 miles; but even that space would only be a fraction of the distance illuminated by the electro light —hence for beacons and lighthouses its value is altogether incalculable. I am unable, of course, to determine the cost of production—the only element required for its universal welcome and reception. *Mining Journal.* J. MURRAY.

Mr. Pepper delivered a lecture on this subject at Crosby Hall, on Thursday last, which was very fully attended. In the course of the evening, the newly-patented electric light was exhibited. It completely obscured the gas light by which the hall is

usually lighted. Mr. Pepper stated that the light was estimated by the first philosophers of the day to be equal to the illuminating power of 800 candles.

APPLICATION OF THE ELECTRIC LIGHT TO RAILWAY PURPOSES.

[We quote the following notice from the *Morning Chronicle*. M. Le Molt, the party alluded to, obtained for England on the 20th July last. As his patent is still unspecified, we cannot say what amount of novelty (if any) there is in his invention, but we have reason to believe that it consists merely in some supposed, and, at best, subordinate improvements on the plans of Mr. Staite, to whom the merit of first applying electricity to lighting purposes in this country undoubtedly belongs.

"On Saturday night, 18th inst., an experiment was made on the Great Western Railway, to test the power of a new species of light produced by electricity, particularly with a view to its being used by railway trains. The light is produced by an apparatus invented by M. Le Mott, a French gentleman. At half-past six o'clock a truck, containing a wooden square box, about the size, though not the shape, of a sentry-box, and having a galvanic battery of some sixty or seventy small jars disposed around it, was attached to the last carriage of the train then about to proceed from Paddington. The light was produced inside the box, and the rays, condensed and heightened by a powerful reflector, were emitted by an aperture contrived for the purpose. The light was produced before the train left Paddington, when a dazzling blaze filled the whole of the spacious station, casting the numerous gas lamps there completely into the shade. As the train proceeded on its way, the reflection left a long train of clear bright light for the distance of a mile and more behind it, in such a manner as to render it utterly impossible that any train coming up behind should run into it, except as the effect of deliberate intention. The reflection, as seen from the carriage, was very beautiful, the prismatic colours being distinctly and vividly delineated along the outer edge of the circle of radiation; and as these fell upon the dense column of smoke ascending from the engine, the effect was singular and striking. The night was dark, but clear, and, so far, favourable to the experiment; and objects, such as a bridge, were rendered distinctly visible at the distance of about two miles. The experiment was made as far as Slough, on arriving at which station the truck was detached from the train, and continued there for about half-an-hour, till the up-train arrived, with which it returned to town. The experiment afforded great satisfaction to all who witnessed it. The only drawback being that the apparatus, having been in the first instance adapted for stationary experiments, suffered considerably from the jolting inseparable from railway motion, a defect which the inventor considered might be with ease overcome in any future experiment. This is, we understand, the first time that light produced by electricity has been applied to railway purposes; and if its use should be found practicable, there can be no doubt that it will add greatly to the safety of night travelling by railway."

MATHEMATICAL PERIODICALS.

(Continued from page 438.)

XII. *The Scientific Mirror*.

Origin.—This periodical was begun at Bolton-le-Moors in Lancashire, under the title of "The Scientific Mirror, a Literary, Mathematical, and Philosophical Repository." It was "designed as an introduction to the Mathematics in general, to lead the ingenious youth to an acquaintance with the Sciences, and the application of them to the various purposes of Society." Two numbers only were published, of which the first appeared in November, 1829, and the second in June, 1830.

Editor. Mr. Charles Holt, Teacher of the Mathematics, &c., Houghton, near Blackburn.

Contents. The first number contains new Enigmas, Charades, Rebusses, Anagrams and Queries; a selection of questions for youth, and sixteen Mathematical Questions for senior students, several of which were selected from those left unanswered in the "Student's Companion." The second number contains answers to the enigmas, &c.; together with new ones proposed for solution. After the answers to the mathematical questions, sixteen propositions of the "Modern Geometry" were reprinted from the "Student," as were also ten of the problems on "Lineal Sections" from the same work, to which algebraical *results* were annexed by the Editor. Messrs. Baines, Holt, and Clay were the principal contributors to the literary department, and Mr. John Hope, the *Laureate* of

the *Diary*, furnished the Prize Enigma for the second number.

Questions. The questions answered amount to sixteen, and an equal number was left unanswered at the close of the work. They are of a similar character to those contained in the "Scientific Receptacle":—The Generation of Curves, their Quadrature, &c.: forming the principal portion.

Contributors. Messrs. Baines, Brierley, Clay, Cole, Cook, Dawson, Ferguson, Godward, Gregson (Norgge), Harrison, Heap, Holroyd, Holt, Hope, Hudspeth, Huntington, Kniveton, Lomax, Middlemiss, Paxton, Stringer, Walsh, White, Whitworth, &c., &c.

Publication. The work was issued half yearly:—it was printed for the proprietors by John Ogle, of Bolton, and sold by Messrs. Davis and Dixon, Messrs. Hamilton, Adams, and Co.; and Messrs. Hurst, Chance and Co., London.

THOMAS WILKINSON.

Burnley, Lancashire, November, 1848.

(*To be continued.*)

PROFESSOR MOSELEY'S INVESTIGATION OF THE PRESSURE OF THE EARTH AGAINST REVETEMENT WALLS.

Sir,—I cannot understand why "A Constant Reader," if he has read to the 443rd page of "Moseley's Engineering and Architecture," should find any difficulty in differentiating the equation

$$\mu = \cot(\iota+\phi) \quad \frac{du}{d\iota} = \frac{-1}{\sin^2(\iota+\phi)}$$

is quite correct, and I beg to enclose a demonstration.

By well known theorems in plane trigonometry

$$\omega = \cot(\iota+\phi) = \frac{\cos(\iota+\phi)}{\sin(\iota+\phi)} = \frac{\cos\iota\cos\phi - \sin\iota\sin\phi}{\sin\iota\cos\phi + \sin\phi\cos\iota}.$$

When, by differentiating with respect to ι,

$$\frac{du}{di} = \frac{-\left(\sin^2(1+\phi)+\cos^2(1+\phi)\right)}{\sin^2(\iota+\phi)}$$

$$= \frac{-1}{\sin^2(\iota+\phi)}$$

The expansion of $\cot(\iota+\phi)$ in the subsequent article, was for the purpose of eliminating and obtaining the value of $\cot\iota$ in terms of ϕ and AB. I am, Sir, yours, &c.,

WILLIAM DREDGE.

London, 10, Norfolk-street, Strand, November 22, 1848.

SPECIFICATIONS OF ENGLISH PATENTS ENROLLED BETWEEN THE 18TH AND 25TH OF NOVEMBER, 1848.

JOSHUA COOCH, of Harleston, Northampton, Agricultural Implement Maker. *For certain improvements in sackholders.* Patent dated August 10, 1848; specification enrolled November 17, 1848.

Most of our agricultural readers are probably acquainted with the apparatus called a sackholder, which is used to keep up the sack while in the course of being filled. Useful as this machine is, it has this serious defect, that it affords no assistance in moving the sack from the place where it is filled to that where it is to be deposited or emptied. The object of Mr. Cooch's invention is to remedy this defect, by adding to or combining with the sackholder the means of promptly and expeditiously moving it from place to place.

A frame or carriage, made of iron (or any other suitable material), is supported by and moves on two wheels. From this frame rise two bearers or supporters, to which the frame of the sackholder is attached by pins or pivots. The sackholder frame has a movable leg, which takes at top into a hook or catch, by which it is secured during the wheeling away of the apparatus with its load. When the sack is filled, it is necessary to place the frame of the sackholder in an upright position (or nearly so), on which the foot of the moveable leg drops of itself into the hook or catch, where it remains while the apparatus is wheeled from place to place. To restore the frame to the proper position for filling the sack, it is only necessary again to place the frame in an upright position (or nearly so), when the leg or foot will be released from the hook or catch, and must be extended to support the frame.

Claim.—I make no claim to the invention of the sackholder by itself; but what I

claim is the construction of a sackholder with wheels or rollers, or other equivalent means of moving the same from place to place, as before described.

WILLIAM TAYLOR, Birmingham, Machinist. *For an improved mode of turning up or bending flat plates of malleable metals, or mixtures of metals, by aid of machinery, into the form of tubes.* Patent dated May 18, 1848; specification enrolled November 18, 1848.

The flat plates of metal which are to be bent into the form of tubes, are to be prepared by rolling the metal, in the usual manner, into long, flat, narrow plates, of suitable length, breadth, and thickness for the intended tubes. The two edges of each such plate being either feather-edged or of the full thickness of the plate, according as the tubes are to be lap-jointed or butt-jointed; and are so formed by rolling, or else by subsequent dressing or cutting, so as to render them truly straight and parallel.

The flat plate of metal is laid flatways upon a long, narrow iron bed, which has a semi-cylindrical concave groove formed in its upper surface, along the middle of its breadth, and extending all its length from end to end. The concavity of the groove is made to fit the exterior circumference of the intended tube. The grooved bed is made to slide successively in the framework in the direction of its length, *firstly*, under a revolving convex roller, which presses down the middle part of the width of the plate into part of the depth of the concave groove, and thereby causes the edges to turn up into angular directions, and the plate to assume the form of a shallow trough or concave gutter; and, *secondly*, under another convex roller, which presses down completely the plate into the groove, and gives it the form of a deep trough or gutter, with semi-cylindrical bottom and nearly upright sides. On passing from beneath this roller, the plate slides over the bulb of a fixed mandril, and, at the same time, between a pair of rollers, the circumferences of which nearly meet, and have axes inclined from vertical positions in contrary directions to one another. The edges of these rollers are conical, but concave to a quadrant of a circle of the same size as that of the groove in the bed, so as to leave a semicircular aperture between their conical and concave circumferences corresponding to the groove. The effect of these rollers is to bend the edges of the already bent plate in towards each other, and down upon the mandril. The plate then slides, with the mandril inside, under another revolving grooved roller, which completes the bending down of the edges, and renders it more effectual and permanent, and the tube thereby completed. The seam may be closed by the means usually employed.

The rollers and other parts of the machine may be driven, through the intervention of suitable gearing, by any prime mover.

The tubes may be made oval or polygonal by forming the groove, the concavities, and convexities of the rollers to suit the required shape.

The patentee states, in conclusion, "that the new invention, whereof the exclusive use is granted to me, consists in the improved mode, hereinbefore described, for turning up or bending flat plates of malleable metal, or mixtures of metals, into the form of tubes, by aid of the machinery hereinbefore described; and although most of the several parts of that machinery have been heretofore used in other machinery, the combination of those parts, one with another, for the purposes aforesaid, and the manner whereby the turning up or bending is performed by such combination, constitute my invention. The peculiarity and novelty of the said combination of parts, and of their said manner of turning up or bending, being, that the flat plate is laid upon a bed, over a long groove therein, which bed, together with the plate, is moved endway forwards, beneath a series of rollers, by action of some of which rollers (either direct action, or by the intervention of a mandril) the middle part of the plate is bended down into such groove, first to a part of the depth thereof, so as to bend the plate to a shallow gutter form, and next to the bottom thereof, so as to bend the plate to a deep gutter form, the two sides of which deep gutter form are (by action of other of the said rollers) afterwards turned inwards, one towards the other, and downwards upon a mandril, either stationary or moveable with the plate, the two sides of the said deep gutter, which are so turned down, either meeting edge to edge or with the edges overlapping, as may be required."

FELIX HYACINTH FOLLIET LOUIS, Southwark, gentleman. *For an improved method or process of preserving animal products.* Patent dated May 26, 1848; specification enrolled November 25, 1848.

The animal products to which this invention is stated to relate are cows' milk, goats' milk, and asses' milk, and the nature of the invention is described as consisting in converting the same into solid cakes or masses, which are soluble in warm water, and capable of preserving for a long time their original freshness and sweetness. The method or process by which the inventor accomplishes such conversion is as follows: He first mixes with the milk in its

natural state a quantity of well clarified raw sugar in the proportion of about four ounces of sugar for each gallon of milk, and then agitates and evaporates it in an apparatus of the following description:—There are three hollow standards which support and communicate internally with a number of horizontal circular boxes. Steam is supplied from any convenient source to the standards, whence it circulates through the horizontal boxes. The milk is contained in open evaporating pans, which rest upon the steam boxes. A vertical shaft passes up through fluid-tight collars, in the centre of the boxes and pans, and turns at top and bottom, in sockets; to this shaft is attached radial arms of a rake form, which, when revolving with it, traverse and agitate the milk in the pans. Rotary motion is communicated to the vertical shaft from any prime mover through the intervention of suitable gearing.

The mode of operating with the apparatus is as follows: The pans are filled to near the top with milk sweetened as before directed; steam is then admitted to the hollow standards and boxes, and kept there at a temperature of from 80° to 90° centigrade (176° to 194° Fahr.), and while the milk is evaporating under the influence of the steam heat, it is kept constantly stirred by turning slowly round the vertical shaft, and with it the rakelike radial arms. As the operation proceeds, the milk becomes gradually thicker and thicker, till it becomes at last like a paste, which as it approximates closely to hardness is taken out of the pans and pressed in moulds into cakes of any suitable form.

Or, when great dispatch is not required, instead of using the apparatus before described, the inventor fills a number of very shallow pans with milk sweetened as aforesaid, to the height of not more than about the tenth of an inch, and leaves it there exposed to the ordinary temperature of the atmosphere till it evaporates to dryness, after which the solid residuum is collected and pressed into moulds as before. If the atmosphere is not in a good hygrometric state for the operation, the pan may be placed in a drying chamber kept at a temperature not exceeding 50° centigrade (122° Fahr).

Or, if milk cakes of a very rich quality are desired to be produced, he proceeds as follows:—He first sweetens the milk, as aforesaid, and warms it to nearly the boiling point, and then leaves it to cool slowly; when it comes to a tepid state, he curdles it by means of rennet or any weak acid; he next throws the whole into a sieve in order to separate the curd from the whey. The curd he washes well with cold water, and then subjects it to strong pressure, in order to free it from any water which it may imbibe in the course of the process, and the whey he evaporates to dryness in order to recover the salts with which it is charged. The curd is next placed in a pan over a slow fire, and stirred continually, and the salts recovered from the whey are thrown in by little and little, accompanied with a small portion of bicarbonate of soda or some other alkali (say one part of the alkali for every twenty parts of the whey salts). After a time the contents of the pan begin to melt and amalgamate, and while in this state a small portion of gum-dragon, in a finely powdered state, may be added, in order to facilitate the solidification of the mass.

The cream of milk is solidified as well as the milk itself, and either by the method or process first before described, or by any of the preceding modifications of it.

Claim.—What I claim as my invention is the conversion of milk and cream into solid cakes or masses by the method or process, and the modifications of the said method or process, hereinbefore described.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Thomas Masters, of Regent-street, Middlesex, for certain improvements in apparatus for making aërated waters, and in apparatus for charging bottles and other vessels with gaseous fluid; also improvements in bottles and other vessels and apparatus for drawing off liquids, in securing corks, or stoppers in bottles or other vessels, and in taps or vent pegs. November 18; six months.

Thomas Cullen, of London, gentleman, for improvements in apparatus for steering ships and other vessels. November 18; six months.

John Juckes, of Rosamond Cottage, Fulham, gentleman, for improvements in furnaces and fireplaces. November 18; six months.

Alexander M'Dougal, of Langsight, Manchester, chemist, and Henry Rawson, of the same place, agent, for improvements in the manufacture of sulphuric acid, nitric acid, oxalic acid, chlorine, and sulphur. November 21; six months.

John Oliver York, of 24, Rue de la Madeline, Paris, engineer, for improvements in the manufacture of metallic tubes. November 21; six months.

William Hood Clement, of Philadelphia, in the United States of America, gentleman, for certain improvements in the manufacture of sugar, part of which improvements is applicable to evaporation generally; also improved apparatus for preparing the cane trash to be used as a fuel. November 21; six months.

Henry Newson, of Smethwick, near Birmingham, for an improvement or improvements in trusses. November 23; six months.

Hugh Bell, of London, Esq., for certain improvements in aerial machines and machinery in connection with the buoyant power produced by gaseous matter. November 23; six months.

Christian Schiele, of Manchester, mechanician, for certain improvements in the construction of cocks or valves, which improvements are also applicable for reducing the friction of axles, journals, bearings, or other rubbing surfaces in machinery in general. November 23; six months.

Peter Llewellin, of Bristol, Gloucester, brass and copper manufacturer, and John Hemmans, of the

same place, brass-founder, for improvements in the manufacture of cocks or valves for drawing off liquids. November 23; six months.

Henry Archer, of Great George-street, Westminster, gentleman, for improvements in facilitating the division of sheets or pieces of paper, parchment, or other similar substances. November 23; six months.

Frederick Bramwell, of Millwall, Poplar, engineer, and Samuel Collet Homersham, of the Adelphi, gentleman, for improvements in feeding furnaces with fuel. November 23; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Nov. 17	1669	William Broughton	South-street, Finsbury	Universal stove.
"	1670	H. Austin	Gwydir House	Drain-pipe, with single half-socket joint.
20	1671	George Perrott	Hive Iron Works, Cork	Portable capstan.
"	1672	James Lyne Hancock	Goswell Mews, London	Self-acting hose-pipe reel.
22	1673	Cobett Whitton	Sixall Heath, Stafford	Remington and Whitton's farmers' and graziers' portable mill.
"	1674	William Kirkwood	Edinburgh	Water-closet.
"	1675	Bryden and Sons	Edinburgh	Safety receiving-box for letters and parcels.

Advertisements.

NOTICES TO CORRESPONDENTS.

A stamped edition of the Mechanics' Magazine, to go by post, price 4d., is published every Friday, at 4 o'clock, p.m., precisely, and contains the Claims of all the Specifications Enrolled, New Patents sealed, and Articles of Utility registered during each week, up to the time of going to press. Subscriptions to be paid in advance. Per annum 17s. 4d., half-yearly 8s. 8d., quarterly 4s. 4d. Post-office Orders to be made payable at the Strand Office, to Joseph Clinton Robertson, of 166, Fleet-street.

CONTENTS OF THIS NUMBER.

Erratum.—In our weekly List of Designs (No. 1318), for "Bingent" *read* "Begent."

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Mechanics' Magazine,

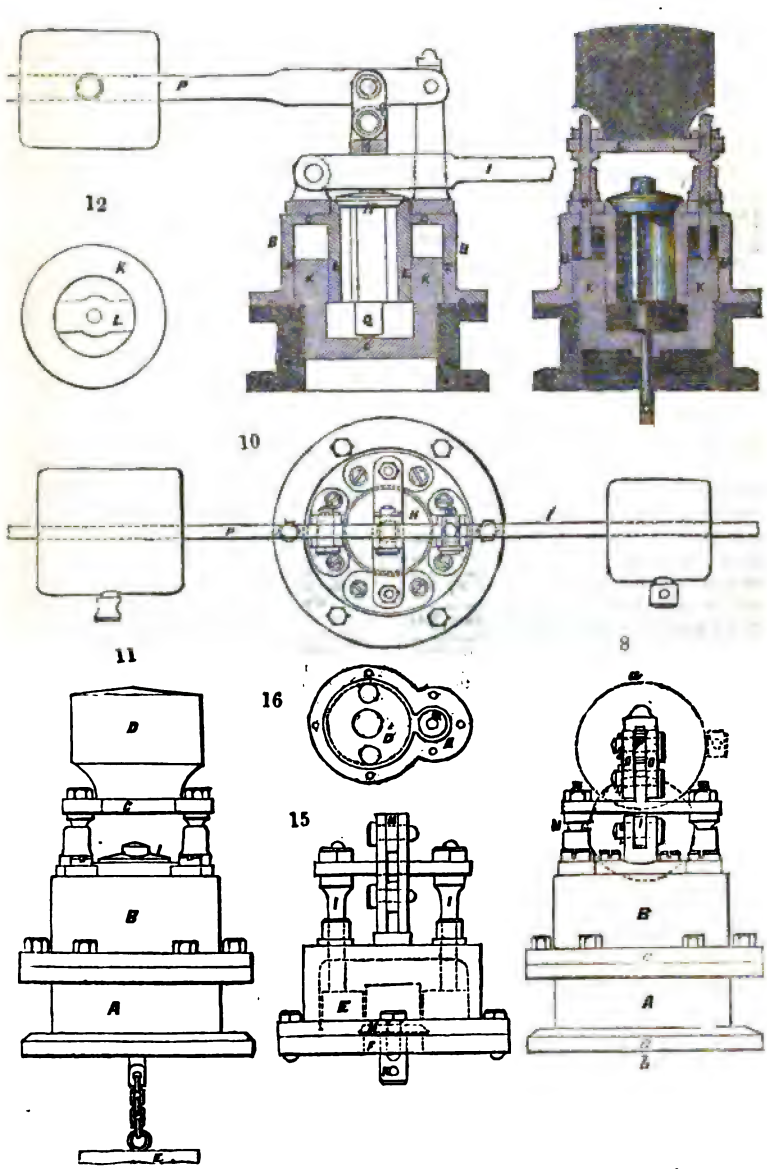
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1321.] SATURDAY, DECEMBER 2, 1848. [Price 3*d.*, Stamped, 4*d.*

Edited by J. C. Robertson, 166, Fleet-street.

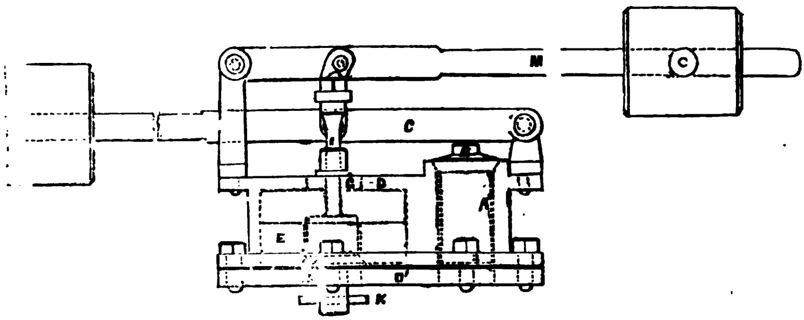
COLE'S PATENT STEAM ENGINE SAFETY VALVES.

Fig. 9. Fig. 13.



COLE'S PATENT STEAM ENGINE SAFETY VALVES.

Fig. 14.



In a former Number (see *ante*, p. 361,) we described some valuable improvements in double cylinder high-pressure engines patented by Mr. Cole. The same patent embraces a new safety valve, which is also well deserving of being brought prominently under the notice of our readers.

This safety-valve is represented in figs. 8, 9, and 10; fig. 8 being an external elevation; fig. 9, a transverse section on the line *a b;* and fig. 10, a plan.

AA is a basement to which the valve-box, BB, is bolted by means of the flanges, CC; the basement itself is secured by its lower flanges, DD, to the steam boiler or other vessel upon which it is to be used. The valve-box consists of two concentric cylinders, E and F, which are joined together at top by an intervening ring of metal, G; or the concentric rings may be cast in one piece, as represented in fig. 9. The inner cylinder, E, forms internally the case and seat for the valve. HI, is the weighted lever belonging to this valve. K, is a second valve or piston of an annular form, which is fitted and ground into the space left between the two concentric cylinders, E and F. At bottom the piston has a bridge, L, which projects some distance downward below its lower surface, but leaves the piston free play, to move up and down within certain limits, between the cylinders E and F. M, is a cross-head to which there are attached on its lower side two guides, NN which pass down through apertures made in the top of the valve-box or case, and rest at their lower ends upon the top side of the annular piston, K. Again, the cross-head at top is connected by two links, OO, to a weighted lever, P. The weights on the levers, I and R, are so proportioned to the area of the valve, H, and the annular piston, K, that the pressure on the latter shall be somewhat in excess over that of the former. When these conditions have been observed; should the valve H, or its spindle, by any chance get stiff or furred up, and consequently cease to act, the increased pressure of steam in the boiler, which is the necessary result, exerting itself upon the lower side of the piston, K, will cause it to rise till the bridge, L, comes into contact with a projecting stud, Q, on the lower end of the valve, H, and lifts that valve for the escape of steam.

Figure 11 is an elevation of a valve similar to that which has been just described, only differing in the manner in which the weights are applied to the valve and the piston. A is the basement of the valve; B, the valve-box; C, the

crosshead which carries a weight, D, equal to the load of the annular piston. E is the weight or load of the valve which is suspended from the lower end of its spindle and occupies a place inside the boiler. It will be seen by reference to the figures that there is a sufficient space left between the top of the valve, I, and the lower side of the cross-head, C, to allow of the valve rising for the escape of steam without its interfering in any way with the piston. Should the valve, however, get fast in its seat, then an increased pressure beyond what the safety valve is loaded to sustain, causes the annular piston to rise till the bridge on its lower side comes in contact with the bottom of the safety-valve, as before described, and causes the valve to rise. A plan of the annular piston employed in this valve is given separately in fig. 12, showing the manner in which the valve-spindle passes through the bridge. Fig. 13 is a section of the valve and valve-box.

A compound safety valve constructed on the same principle as the preceding, but varying in the details, is represented in figs. 14, 15, and 16; fig. 14 being a side elevation, fig. 15, a back elevation, and fig. 16, a plan; A is the valve box; B, the safety valve, which is similar to the common safety valve; C its weighted lever; D is a cylinder which is cast in one piece with the valve box; it is truly bored out inside, and has a piston E, fitted to it; F is a hole in the seat-plate, communicating with the boiler, and G another hole in the top of the cylinder, communicating with the external atmosphere; H is a valve, which is fitted into the piston E, and opens inwards; it is kept in its place by the force of the steam, but when the pressure in the boiler gets too high, it overcomes the load placed on the piston by the weighted lever, M, through the intervention of the guide-rods, I I, and the piston is forced up until the cross-pin, K, of the valve H, comes in contact with the seat-plate, D′, when the valve is prevented from following the piston any further. Should the piston still continue to rise above that point, the valve H is opened and the steam is free to escape.

ON THE STORING OF TIMBER. BY BRIG.-GEN. SIR SAMUEL BENTHAM.

It appears from debates in the House of Commons, as also from evidence given to the Select Committee on Navy, Army and Ordnance Estimates, that the decay to which mast-sticks are liable is so great, and the consequent need of taking made masts to pieces so frequent, as to preclude the use of marine glue in putting them together. This frequent rapid decay of mast timber gave rise early in this country to an investigation of its cause, and was followed by Brigadier-General Sir Samuel Bentham's Minute at the Navy Board of the 21st of September, 1810. Naval economy having of late become a subject of public interest, the publication of that paper may therefore be acceptable, considering besides that private shipbuilders allow their mast timber often to lie afloat, or leave it fully exposed to the weather.

Since 1810, other eminent officers in the naval service have taken the same view of this important subject, but the existence in naval arsenals of mast-ponds and locks, which have been formed at an expense of many hundreds of thousand pounds, has seemed an obstacle to the required change of practice. This, however, did not appear to Sir Samuel as a valid objection to his plans; those mast-ponds and locks, according to his conception, might be turned to uses which would pay a fair interest for the money which had been sunk in their construction. The mast-locks would need only a facing wall, and pipes and channels for ventilation, to convert them into excellent store cellars; the ponds might become basins for fitting vessels, accommodations amongst the most thrifty of any in a Royal Dockyard.

Minute, &c.

Having been called upon to furnish plans for receptacles for mast timber and made masts, as well as for working mast-houses for Portsmouth and Sheerness Dock-yards, I must observe, that on a review of the plans I had already long ago submitted to my Lords Commissioners of the Admiralty for accommodations for the mast-making department in Portsmouth Dock-yard, they still seem to me very adequate to the purpose, supposing it advisable to keep mast timber *under water*. A great deal of time and attention having been bestowed in preparing those plans, so that according to them the greatest effect might be produced in the least space, at the cheapest rate, and in the shortest time, as exhibited in my several letters on the subject to the Admiralty—on the supposition therefore, that mast timber were still to be kept under water,

these same plans, with very little alteration to suit them to the local situation, would render them likewise the most advisable for Sheerness-yard. Consequently, by recommending the immediate execution of these plans I should be able to furnish the working drawings for them with very little trouble, and in the course of a few days.

The Board are, however, aware, that the doubts which I entertained from the first respecting the expediency of keeping mast timber under water having gradually increased, I have lately made it my business to investigate this point more fully,—that it was in consequence of this desire of farther information on the subject that the Board at my request obtained separate opinions from various officers of the several dock-yards respecting the keeping mast timber under water—and that since then, I have myself obtained farther verbal explanations and information from some of the most intelligent of those officers and other persons. The result of this inquiry, as well as my own late observations on mast timber in the dock-yards, has proved to me that mast timber should be kept, like all other fir timber, not under water, but dry under cover, in receptacles capable of admitting a full current of air, or of being shut up, more or less, so as to diminish or prevent entirely the current at pleasure, according to the different states of the atmosphere, or the different degrees of dryness of the timber; and that the timber should be so arranged within them, as that the logs should admit the air between them.

The reasons in favour of keeping mast timber so stowed dry are as follows:—

First. That mast timber being no other than fir timber, cannot in regard to its species be supposed to be capable of good preservation in circumstances different from those in which fir timber for purposes other than those of mast-making is best preserved—that fir timber for all other purposes, excepting mast-making,—as for the construction of ships and their appendages, as well as in house carpentry,—is universally allowed to be in the best state for working up, as well as for long duration of the timber itself, when it has been duly seasoned and dried under cover from rain, but at the same time ventilated without having a current of air passing amongst it so quickly as to rend the timber; and as my own observations in this country and in other very different climates have given me reason also to accede to this general opinion, so I cannot but be of opinion, that the same log of fir timber, which all would agree to keep dry if for ship use or house carpentry, should likewise be kept dry, although in the appropriation of the log it had happened to have been denominated a mast log, instead of having been destined for a beam, a rafter, or to have been cut into scantlings or planks.

Secondly. That in regard to a log of fir timber when put to use, whether in a mast, or in the form of a beam, or of plank, it appears to me that it would be in the form of a mast that fir timber would be most injured by being water-soaken, since even as a beam, wet timber would be exposed on most of its surfaces, for some time at least, to the air, and it would not at any time be totally excluded from it, so that the water the timber had imbibed would be gradually evaporated; and still more so in small scantlings, or plank; but a water-soaken log of fir timber, if worked up into a mast, and covered with a coating of paint or any other coating impervious to water, would necessarily still remain wet, since no evaporation could take place through the external coating of paint, &c., and consequently, the water cased up between the fibres of the wood could not be expected to do otherwise than produce a preternatural decay of the mast.

Another very great mischief arising from the use of mast timber imperfectly dried is, that however well the parts may be put together at the time of making, yet by the shrinking of the wood afterwards, as it dries, the hoops, on which the connection of the parts together, principally depends, become slack, and the mast thereby, while in that state, is rendered unfit for service.

That in regard to the kind of water in which the logs are kept, it has been found that in fresh water they decay very rapidly, and in salt water they are liable to be eaten by the gribble worm; besides which the salts imbibed into the log with the sea water, being some of them such as attract water from the atmosphere, would, inasfar as the quantity imbibed could do so, have the effect of keeping the log constantly moist when-

ever it should be exposed to a humid atmosphere.

Thirdly. Although there are various examples of the extraordinarily long duration of wood whilst kept constantly immersed under water, yet it has been observed that timber having been so immersed decays the sooner, and in some cases very rapidly, when taken out of water and exposed to the air.

Fourthly. That although it were true that timber to be stored for a great length of time should be kept under water, yet it should be taken out so long before its use as should be sufficient to dry the log perfectly, yet gradually, so as not to make it shakey; that length of time, perhaps three, four, or five years, according to the thickness of the log, is as long a time as that for which any store of mast timber need to be kept, and much longer than it, generally speaking, is kept in any of the dock-yards; and that therefore nearly as ample a provision of drying-houses would require to be made over and above mast-ponds and locks as need to be made for receiving a due store of mast timber without any such submarine receptacles.

Fifthly. That even in the event of a long peace and the keeping the same store of mast timber for a great length of time, I can see no reason why it should be more liable to injury in a *rough* state, if kept in well-constructed mast-houses, than the same timber worked up into a mast.

In thus recommending this change of practice, I am well aware that the *number* of those who have given their opinion in favour of keeping mast timber under water exceeds that of those who would keep it always dry; but the Board will observe, that they are *all* decided on the expediency of keeping fir timber for purposes other than masts always dry, and that in regard to timber for masts, they *all* express great anxiety that it should be taken out of the water a sufficient time to dry it perfectly previously to its being worked up.

Those who enter most into the question are decided as to the injury fir timber in general (some sorts more than others) suffers from being kept under water. Some state the particular mischief arising from having been wet with salt water, and all who propose the keeping in salt water mention the necessity of precaution against worms.

I am therefore proceeding to prepare new plans for the mast-making department in Portsmouth and Sheerness Dock-yards, according to which all the timber unconverted, as well as converted, as also the masts themselves, may be kept dry and duly ventilated in such manner as may be suitable to the several purposes, with the means of getting out any particular log or piece of mast with little or no derangement of the others.

S. BENTHAM.

September 21, 1810.

MM. THOMAS AND DELISSE'S PROCESS OF CLEANING METALS.

We mentioned (*ante* p. 404) a new process of cleaning metals discovered by Messrs. Thomas* and Delisse. The process has been patented in this country on their behalf by M. Fontainemoreau, who has obligingly favoured us with the following copy of the specification. The title of the patent is for "Certain improvements in separating or dissolving oxides from metals and metallic substances."

Specification.

The improvements in dissolving or separating oxides from metals and metallic substances consist in introducing into the acids used as agents for the scouring of metals and metallic substances, an organic body in solution, by the presence of which the metal is preserved from the corroding action of the agents employed. All soluble organic bodies do not possess the above property —but there are a great many which do; and the operating cause in that case not being known to chemists, it is as yet impossible to assign a general law for this phenomenon, or to define with exactness the characteristics of such substances as combine the above stated preserving principle. Nevertheless, I will enumerate clearly those which I particularly employ.

Firstly.—The proximate or principle resulting from vegetables which are soluble in water, such as sugar, manna, gum, &c.

Secondly.—The extracted, colouring, bitter, astringent, or neutral principle, such as the extracts of wood or plants, the juice of plants, tanning, &c.

* This gentleman is the *M. Emile Thomas*, who has lately acquired some notoriety in connection with the *Ateliers Nationaux* of Paris.

Thirdly.—The products of dry distillation of organic substances, such as the produce of distillation of wood, coal, &c.

Fourthly.—The products, such as the saponification of fatty bodies, or resin obtained by means of an alkali, such as soap, glycerine.

Fifthly.—The products of the treatment of organic bodies, soluble or not soluble, with concentrated acid or with an oxygenating or disoxygenating substance, such as cellutore, fecula, starch, oil, resins, tallow, when heated by means of concentrated acid, or by chlorine, &c.

There are some substances which I employ preferable to others, because the results are better, and at the same time less expensive in procuring, such as tar, oil, the cakes of oleaginous seeds, previously heated at a warm temperature by means of concentrated acid, and glycerine hitherto without any use, which produces in this application a very good effect. For the purpose of scouring the metal, I follow the ordinary method, and all the several processes to which the metal is frequently subjected, with the exception that to every hundred gallons of acidulated liquid employed for the operation, I add from one to fifty gallons of the organic substances before mentioned; by such an addition I obtain a complete solution of the oxide, preventing in the mean time a more or less portion of the metal from being dissolved, avoiding therefore a perceptible loss to the manufacturer, and many accidents deteriorating the quality of the metal.

And having now described the nature of the said invention communicated to me, and the manner in which the same is to be performed, I wish it to be understood that what I claim as my invention is, the limiting the action of the acids to the separation and solution of the oxides by adding to them, in the manner before stated, an organic body.

MR. WYNDHAM HARDING'S SAFETY ADDITIONS TO RAILWAY CARRIAGES.

It will be recollected that some months ago numberless schemes for communicating between the guard and driver of a train or between the passenger and guards, were referred to the Railway Commissioners, and that the late Col. Brandreth, R.E., the commissioner, who directed his especial attention to the subject, selected as the most practical suggestion made, the plan adopted by Mr. Wyndham Harding on the Bristol and Gloucester Railway. This plan consisted in extending the foot-boards, and placing holdfasts along, and at the ends of the passenger carriages, and footholds on a narrow foot-plate, as well as holdfasts along horse-boxes and goods'-trucks, so that the guard could at all times safely walk along the train to the engine, or visit any particular part of the train where he suspected anything wrong, as an axle heating, or any such casualty. It appeared that these contrivances had prevented more than one serious accident on the Bristol and Gloucester Railway.

We believe that this was Mr. George Stephenson's original idea on the Liverpool and Manchester Railway; but whether this was so or not, it has been entirely lost sight of in modern carriages, and the footboards are now frequently so cut off and the holdfasts omitted, even in passenger carriages, that a guard can only with extreme difficulty and at great risk get along a train along the roofs of the carriages, while a horse-box or goods'-wagon completely stops him.

We have ourselves known instances where this has led to accident, not only to the guard himself but to the train; and we have all heard of cases such as that of Lady Zetland, where even a burning carriage could not be reached, nor could any communication be made along a train in case of urgent danger, from the absences of the means adopted by Mr. Harding.

It is clearly wrong to perch a guard up, as we now do, on an isolated box with nothing but a flag or a lamp (which may go out) wherewith to attract the engineman's attention, which he may not be able to do for miles, as was lately the case at the Sowerby-bridge accident; he himself also being unable frequently to get to any part of the train—although he may suspect something is wrong, and even hear the cries of a passenger. There should, it appears to us, evidently be the means of getting along a train in motion, both for the sake of passengers as well as the guards.

As there is a large quantity of carrying stock now in course of construction, we have thought it well to draw attention to the subject, and to remind carriage-builders of a suggestion which has been successfully tested in practice.

GEOMETRY OF THE LINE AND PLANE.—BY T. S. DAVIES, F.R.S., L. AND E., F.R.S.A., ROYAL MILITARY ACADEMY, WOOLWICH.

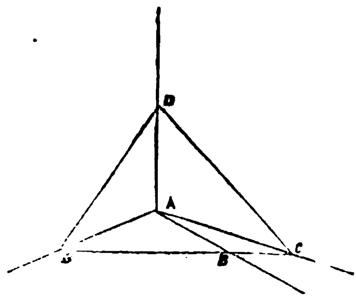
(Continued from page 497.)

Prop. XLVII.

In every trihedral angle, the plane angles of the faces are such that :—

(1.) *The sum of any two is greater than the third angle;*

(2.) *The difference between any two is less than the third angle.*



(1.) Let the trihedral angle A be contained by the three plane angles BAC, CAD, DAB; then the sum of any two of them will be greater than the remaining angle.

The varieties of possible magnitudes amongst these angles are:—

(α.) All three equal.

(β.) Two equal, and each of them greater than the third.

(γ.) Two equal, and each of them less than the third.

(δ.) All unequal.

Case (α). Since all three are equal, the sum of any two of them is double the third angle, and hence greater than the third.

Case (β). Since each of the angles (DAC, CAB for instance) is greater than the third (BAD) much more is their sum greater than it.

Also, since (hypoth.) DAC, CAB, are equal, the sum of either of these and the third angle DAB is greater than the other of them.

Cases (γ and δ). Let BAC be the greatest angle, the other two BAD, CAD, being equal to one another, or not.

In the edges AB, AD, take any two convenient points B and D; in the plane BAC make the angle BAE equal to BAD; and take AE equal to AD. Draw BE to meet AC in C; and draw CD, DB completing the triangle BCD.

Then (*Euc. i.*, 5.) the base BE of the triangle BAE is equal to the base BD of the triangle BAD.

But (*Euc. i.*, 20.) the two sides BD and DC together are greater than the side BC; and it has been shown that BD is equal to BE. Hence DC is greater than CE.

Again, since the triangles DAC, EAC have the sides about the angle DAC equal to those about CAE each to each, but the base DC greater than the base EC, the angle DAC is greater than EAC. Consequently, the angles BAD, DAC together are greater than the angles BAE, EAC together; that is, than the third angle BAC.

(2.) The sub-cases are the same in this as in the preceding, and will here be taken in the same order. The sub-cases (γ, δ) will however require the aid of the following lemma, which though found in most modern treatises is not given in Euclid's Elements.

The difference between any two sides of a triangle is less than the third side.

Every reader who has been able to follow the preceding reasonings will deduce this truth so readily as to render it superfluous to give a formal demonstration in this place.

CASE (*a*.) When the three angles are equal the difference between any two is nothing, and therefore less than the third angle.

CASE (β.) The difference between the two greatest angles is nothing, and hence less than the third angle.

Also, the difference between either of these equal angles and the third is less, (obviously, from the signification of the terms employed) than the other of them.

CASE (γ.) If BAD, DAC be equal to one another, their difference is nothing, and hence less than the third angle BAC.

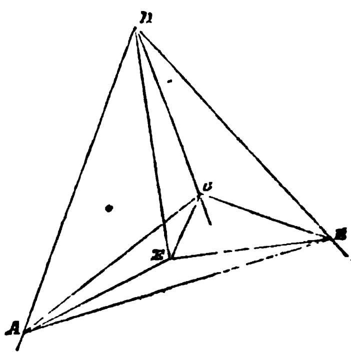
Also the difference between either of them and the third angle BAC, which is greater than either of them, is less than the other of them. For otherwise they would together be equal to or greater than BAC:—which is excluded from being possible, by the former part of the proposition.

CASE (δ.) It will be shown with perfect ease, as in the corresponding preceding sub-case, that the difference AEC between the angles BAC, BAD is less than the third angle DAC; whichever of the two angles BAD, BAC be the greater.

PROP. XLVIII.

Every salient solid angle is contained by plane angles, which are together less than four right angles.

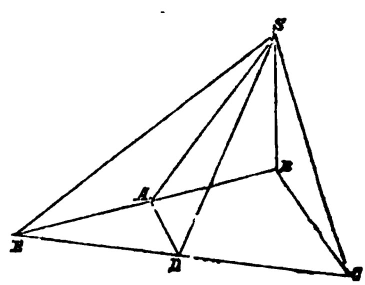
(*a*). Let the angle D be trihedral; take DA, DB, DC all equal; draw the perpendicular DE to the plane ABC; and join EA, EB, EC.



Then, since DEA, DEB, DEC are right angles, it readily follows from (I. 47) and the conditions of our construction, that AE, BE, CE are equal, and hence that E is the centre of the circle about ABC. Whence the perpendiculars from E to the sides of the triangle falls *between* the extremities of those lines, since those perpendiculars bisect the sides.

Wherefore ADB, BDC, CDA are respectively less than AEB, BEC, CEA; and hence their sum less than the four right angles to which AEB, BEC, CEA are equal.

(β). Let the angle S be tetrahedral, and produce two noncontiguous faces to meet in SE; also, let the system of planes be cut by any other plane, ABCDE.



Then, by the preceding case, the angles ESB, BSC, CSE are less than four right angles. But (*prop.* XLVII.) the angle ASD is less than the two ESA, ESD; and hence the angles ASB, BSC, CSD, DSA are less than ESB, BSC, CSE; and therefore, *à fortiori*, less than four right angles.

(γ). In all other cases the sum of the plane angles may be shown to become less and less as their number is increased; and hence, that the proposition is true in its most general form, as long as the dihedral angles are salient.

Scholium.

The modes of treating propositions XLVI. and XLVII. were first given by me, in the *Cambridge and Dublin Mathematical Journal*, for November, 1847.

(*To be continued.*)

THE SEA-WALL QUESTION AGAIN.—ON THE NOTE TO SIR HOWARD DOUGLAS'S "PROTEST."

Sir,—Certain of your correspondents, out of an important subject, have made so much bye-play for the exercise of their skill in argumentation, that, like many other disputants, they appear to have quite lost sight of the original subject; at least, if they do not, some of your readers may require, by this time, to be informed that the matter in dispute has something to do with sea-walls or breakwaters. To one of the parties, at least, may perhaps not unaptly be applied the character given by Goldsmith to the village schoolmaster—

"E'en though vanquish'd, he could argue still."

And as, like refractory jurymen, the belligerents do not seem likely to agree together, would it be improper for a stranger, in the expectation that the parties may be spared the loss of any more of the time, which is probably valuable to them, to throw his evidence into one of the scales?

I have had, in my time, something to do with under-shot water-wheels and steam-ship paddle-wheels; and I have read a little concerning the pressure of fluids on bodies immersed in them; yet, if it should be thought a piece of vanity in me to consider myself competent to offer an opinion on the theory of such pressures, there will, probably, be no objection to my bringing forward the authority of the distinguished Dr. Young, who shows distinctly, as a *theoretical* principle in the pressure of fluids on plane surfaces oblique to the axis of motion, that the pressures vary with the square of the cosine of the angle of incidence; that is, the square of the sine of the angle which the axis of motion makes with the plane (the angle of incidence being the angle between that axis and a perpendicular to the plane which is the complement of the other angle). It is true, that this is only an approximation to the law of pressure, and depends on the assumption that when a fluid particle has struck the plane, it is immediately annihilated, which is anything but consistent with the nature of fluid action; but the results of experimental pressures show that, in reality, the exponent of the sine of the inclination is less than 2. Dr. Hutton, from experiments with the whirling machine, has found that the pressure might be represented by a (sin. θ) $1{\cdot}84\ \theta$ [Tracts, vol. iii., p. 208,] from which it is evident that the resistance, instead of varying with the cube of the sine of the inclination, varies with a power of the sine which is always less than the square, and which, when θ is above 57° 7′ would even become less than the first power. The experiments were made in air, but the above exponent of sin. θ is the same for all fluids, the numerical coefficient a alone being different for different fluids, and this depending on their density.

All writers on hydrodynamics, in making the pressure on a plane vary with the cube of the sine of the inclination, contemplate a plane of *given dimensions*, which is supposed to make a variable angle with the direction of the motion, and, therefore, receives the action of a variable number of fluid filaments; but this is a very different case from that of a sea-wall, whose height is constant, or from that of a plane, like a side of a wedge moving parallel to itself in a fluid.

And I cannot help remarking here, that "Ratio" is in error when he assumes, p. 469, *ante*, that it is competent for him to expand n in terms of ϕ; supposing this were possible in any other form than

$$n = \frac{\sin.\ \phi}{\sin.\ \phi}$$

multiplied by a constant, that is $n = a$ constant, there would arise the absurdity that the pressure on a plane would, in the same circumstances or at the same time, vary both as $\sin.^2\ \theta$ and $\sin.^3\ \theta$.

I am, Sir, yours, &c.,

A STEAM-SHIP AND WATER-WHEEL ENGINEER.

MR. STEPHENSON'S EXPERIMENTS ON THE LATERAL FORCE OF WAVES.

Sir,—Whether as engineers we are anxious for sea-walls to be monuments of constructive skill, and to obtain the best form of section to withstand the fury of the waves,—or, as scientific men, we endeavour to investigate the action of the sea, and demonstrate its effects when meeting an impediment to its onward motion,—or whether, with a commercial or philanthropic spirit, we wish to promote this class of works to afford harbours of refuge for the "tempest-tossed" mariner,—the subject possesses interest in all its phases, and the principles involved are in every respect worthy the consideration it has received and the space it has lately occupied in the pages of the *Mechanics' Magazine*.

The spirit and ability with which your numerous correspondents have urged their arguments in support of their several views, have given much interest to the discussion. It is, therefore, the more to be regretted that, forgetting the broad principles and scientific importance of the subject, they should condescend to quibble about the form of an equation, which does not at all affect the question at issue.

It matters not whether we write AC $q \sin^2 \phi$, or AB $q \sin^3 \phi$, for the effect of the water upon the sea wall; for, under every possible variety of circumstances, AC = AB $\sin \phi$. But though these equations are equal to each other, there is a quantity involved in both, the meaning of which is to me extremely unsatisfactory, and may well give rise to the question, What is the letter q intended to represent?

In answer to this, I shall, of course, be told that it is the pressure on each square unit of surface, demonstrated by Mr. Thomas Stephenson at a maximum of $3\frac{1}{4}$ tons per square foot. This appears to be the meaning your correspondents give to q, and their calculations are founded upon this data. Most assuredly this is an erroneous view of the matter, and all calculations founded on such data must be wrong, and will only mislead those who depend upon them. The pressure of q, or if we say $3\frac{1}{4}$ tons per square foot, is a statical pressure registered at the instant the spring of the dynamometer was in equilibrium with the force of the sea; but the force of the waves acts with a dynamic or moving force, involving both weight and motion, and cannot be expressed without taking into consideration both these elements. It is, therefore, impossible to be represented by a statical force, or expressed by the letter q (so long as it retains the value q = the pressure on each unit of surface.) It appears to me that if we retain the quantity q in the equation, its value should be

$$q = \frac{\delta v^2}{2g}$$

where δ = the density of the water, v = the velocity of the water in feet per second, and

$g = 32\frac{1}{6}$ feet. Substituting this value of q, the effect of the waves on each unit of wall is

$$= \frac{\text{AC}\ \delta\ v^2}{2g} \sin^2 \phi,$$

or else, which is the same thing,

$$\frac{\text{AB}\ \delta\ v^2}{2g} \sin^3 \phi.$$

I do not question the correctness of Mr. Stephenson's experiments, or their value, if judiciously applied; but I certainly think the application has hitherto been very erroneous.

The experiments alluded to were made with a marine dynamometer, off the Skerryvore Rock, and recorded the maximum pressure of the sea, during a heavy gale, at $3\frac{1}{4}$ tons per square foot. The helical spring was compressed to that extent, and that at the instant of greatest com-

pression the effect of the spring to recover its original form and the pressure of the water were in equilibrium there can be no doubt. The onward motion of the waves was repressed by the spring, and the recoil of the spring prevented by the force of the wave. For at the instant of registration both were at rest, and a statical pressure of 3¼ tons recorded. But will this satisfactorily express the work done by the sea upon the spring? Will it show the amount of work expended in compressing the spring from zero to 3¼? Most assuredly not. For as a statical pressure cannot be taken to represent a dynamic force, so neither can the maximum pressure on the spring of the marine dynamometer be taken to represent the *vis viva* of the waves acting upon it.

In our every-day concerns we experience no difficulty in computing the *vis viva* in a moving body, or the work in a machine; in a steam-engine, for example. We are in no danger of confounding the maximum pressure of the steam with the velocity of the piston, or in the computation of its power omit this element altogether from the calculation. The pressure of water against the floats of a water-wheel is multiplied by the velocity of the wheel; to give the result in work we commercially reduce to horse-power. If in each of these, and in every other similar case, we distinguish so clearly between statical pressure and dynamical force, why should we confound them in estimating the action of a wave? We multiply the pressure of the water by the distance through which it forces the wheel to ascertain its effect. Why then should we not multiply the pressure on the spring by the space through which it is compressed to ascertain the effect of the wave on it?

It appears to me that, in order to ascertain the effect of the sea upon the dynamometer, we should assume the resistance to the compression to be partly constant, as the friction of the stem through the collar, &c., and partly variable as the resistance of the spring (increasing in the direct ratio of the compression;) and that we should therefore consider the force actually employed at any instant of time as $=(f+ax)$, and the work done through an indefinitely small space as $=(f+ax)dx$, where $f=$ the constant resistance from friction at the collar, &c., and $ax=$ the resistance by the spring at any variable distance, x. Put then $S=$ the total space through which the spring is compressed when it registers the maximum pressure.

Whence integrating between the limits of $x=0$ and $x=S$ we have for the effect of the water per square unit

$$=\frac{S(2f+aS)}{2},$$

and as the work is always equal to one half the *vis viva* of the moving body—

$$\frac{S(2f+aS)}{2}=\frac{\nu v^2}{2g},$$

Wherefore, substituting the value for q, we get for the effect of the sea upon each square unit of the wall $=$

$$\frac{AC}{2}S(2f+aS)\sin.{}^2\phi-$$

The numerical value of which must be supplied by experiment.

I remain, Sir, yours, &c.,

WILLIAM DREDGE.

London, 10, Norfolk-street, Strand,
November 22, 1848.

CYLINDER CASTING.

A cylinder of unusual magnitude was cast on Wednesday, November 21, at the Haigh Foundry, Wigan, in the presence of a great number of persons, who had been attracted from various parts of the surrounding district to witness the novelty of so large a casting. The cylinder is 8 feet 4 inches diameter, and about 17 feet long, and is intended for a direct action pumping engine to be erected at the Mostyn Colliery, Flintshire. The weight is about 22 tons, and the quantity of metal melted was nearly 30 tons.

We believe this is the largest steam-engine cylinder in the world, with the exception only of those employed in pumping the Haarlem Lake in Holland.

No accident occurred during the operation; and as soon as it was ascertained that it was a "good run," a small discharge of gunpowder gave the signal for many hundreds of workmen and others to give three times three cheers, which was done with hearty good will.

The Haigh Foundry Company have erected a boring mill for the purpose of boring this cylinder, and they have made it of sufficient capacity to bore one of 11 feet diameter, and 19 feet in length.

SALTER'S PATENT SELFACTING DRAIN-FLUSHING APPARATUSES.

(Concluded from page 507.)

Fig. 5.

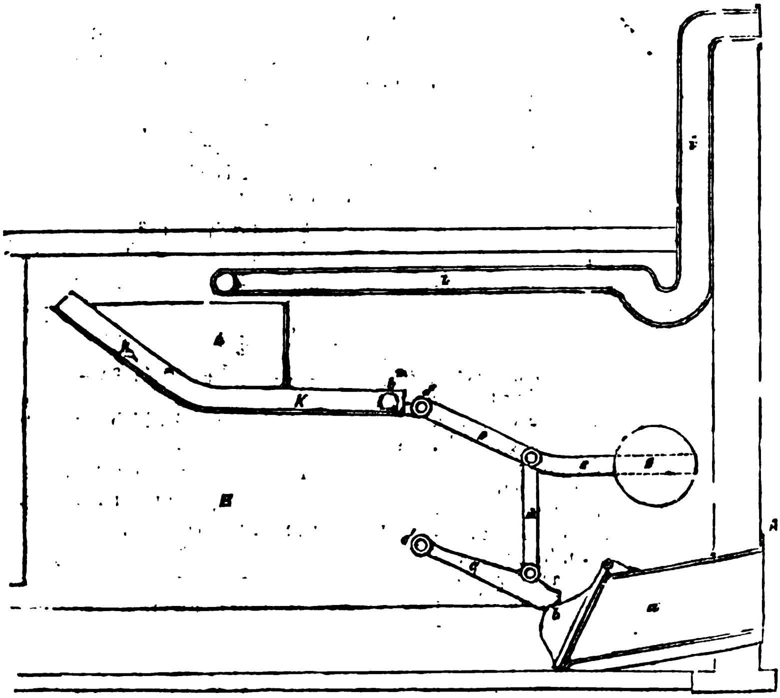
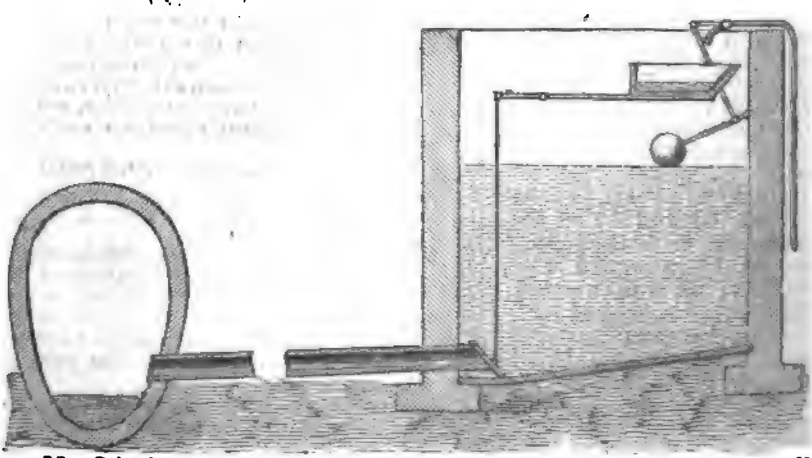


Fig. 15.



Mr. Salter's contrivances for drain-flushing are remarkably ingenious, and literally what he styles them — self-acting." It seems just as impossible that

Fig. 8.

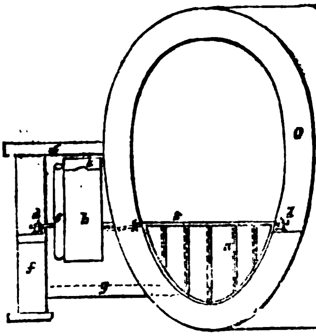


Fig. 9.

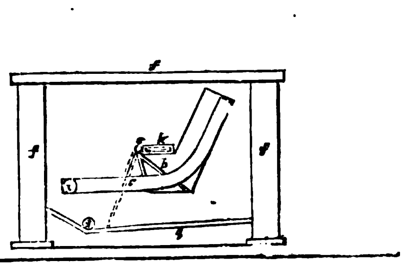


Fig. 10*a*.

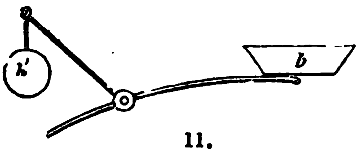
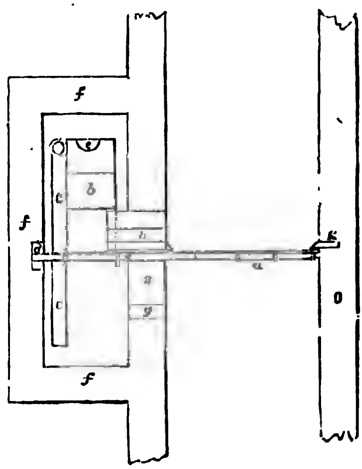


Fig. 10.



11.

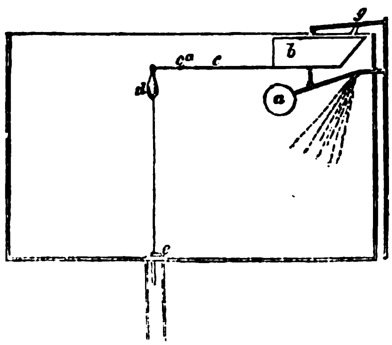


Fig. 11*a*.

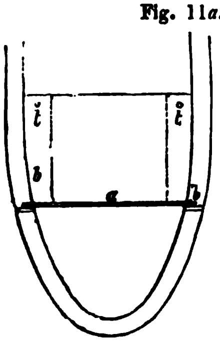
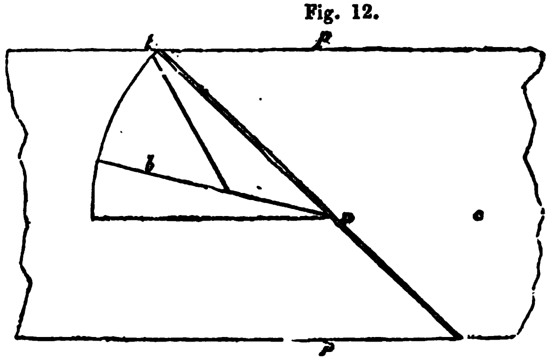


Fig. 12.



they should fail to act when required, as that they should miss accomplishing most completely the office assigned to them. Mr. Salter describes them as consisting

generally in "attaching to sewers, drains, and cesspools, a self-acting flushing apparatus, whereby water or any other liquid substance passing along or through such sewers, drains, cesspools, and other similar conduits and receptacles, is pent up or retained therein at certain points or places, until it attains to such a height as to flow over into and fill one or more basins or vessels suspended in chambers or recesses made or constructed outside, inside, or at the top, or other suitable part of the said sewers, drains, cesspools, or other conduits or receptacles, on the filling of which basins or vessels, they drop down, and thereby open a valve or flap, by which the pentup water or other liquid substance is released, and rushes out with a velocity proportional to the height and quantity of the fluid." A side view of a self-acting flushing apparatus on this plan is represented in fig. 5.

Fig. 13.

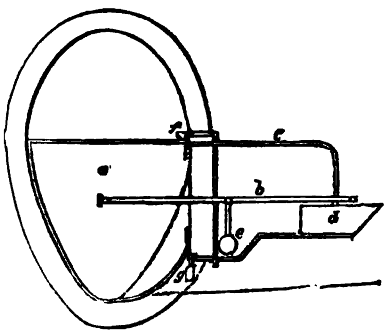
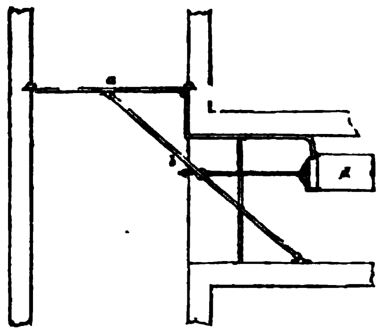


Fig. 14.



A represents the front wall of a reservoir or receptacle in which the water or other liquid substance is supposed to be pent up; B is a recess or chamber, formed on the outside of A, for the purpose of containing the flushing apparatus; *a* is a passage at the bottom of the reservoir, cesspool, or receptacle, through which the contents of it are discharged; *b*, a valve or flap, which covers this aperture, and may be made water-tight either by an exact adjustment of the surfaces brought in contact, or by the use of washers of vulcanized India-rubber or gutta percha, or other suitable material; *c* is a stopper, which is centred on a shaft, c^1, and rests on a boss, *b*, which projects from the outside of the flap, and thereby keeps it closed; *d* is a rod, which connects the stopper, *c*, with a lever, *e*, which is centred on a shaft, *f*, to one end of which lever there is attached a basin, box, or vessel, *h*, of the scuttle-like form shown, and to the other a weight, *g*, which is a little less than equivalent to the weight of the basin, *h*, and its contents when full; and *i* is a pipe, which leads from the top of the reservoir, cesspool, or receptacle, and terminates immediately over the surplus receiving vessel, *h*. When the water or other liquid matter in the reservoir, cesspool, or receptacle, rises to the height of the pipe, *i*, it overflows through that pipe into the basin, *h*, and when that basin is full, it drops down, which causes the opposite or weighted end of the lever, *e*, to ascend and carry up with it the connecting rod, *d*, and stopper, *c*, on which the valve or flap, *b*, being suddenly released, the liquid rushes out with great velocity and force. And while this discharge is taking place, the basin, *h*, being tilted up by the action of the lever, *e*, keeps gradually emptying itself until the ball or weight, *g*, becomes so much heavier than the basin with its diminished contents, as to descend and raise the basin; whereupon the flap or valve, *b*, falls back into its original place, and the stopper, *c*, drops upon it, and keeps it closed.

A modification of the preceding arrangement is indicated by the letters *k*

and b^2, figs. 5, 6, and 7, and exhibited more in detail in figs. 8, 9, and 10. In this modification, a moveable ball is substituted for the fixed counterpoise, *g*, or may be combined with it, and made to travel in a pipe or frame connected with and partaking of all the movements of the surplus receiving basin, *h*. Fig. 8 is an end view; fig. 9, side view; and fig. 10 a plan of a sewer fitted with a flushing apparatus constructed according to this modification. *oo* is the sewer; *ff*, the outside chamber, containing the principal parts of the apparatus; *a* is the flap or valve, which is attached to a shaft, *s*, which is supported on pedestals, *dd*; *b*, the basin into which the water flows after the water has risen to one given height, say to *k*, and which is also attached to the shaft, *s*, but at a point below the centre of the basin (see fig. 10). *c* is the pipe in which the ball, *i*, travels; *e* is a hole in the top end of the basin for the escape of the liquid from it (when tilted over, as afterwards explained) into a drain, *g*, communicating with the bottom of the chamber and sewer.

The manner in which this apparatus acts is as follows:—When the liquid rises in the sewer as high as the aperture, *k*, in the wall, it overflows into the basin till the weight of water in the basin exceeds that of the flap or valve, when the basin tilts over, and raises the gate or flap, on which the pent-up liquid rushes out along or through the sewer; and, simultaneously with the tilting over of the basin, the ball, *i*, which was at the bottom, *c*, of the tube, runs to the other end, and serves to keep the basin down until the liquid in it runs out through the hole, *e*, when the valve or flap being somewhat heavier than the basin or vessel and ball together, the flap descends, and the basin ascends, in doing which the ball, after passing the centre, runs back to its original position, and acts as a lever or weight to keep the flap or valve shut.

Or, in place of the moveable ball in the preceding arrangement, there may be substituted a ball, *h*, suspended from a rod, after the manner of a pendulum, as shown in fig. 10^a. As the basin, *b*, falls, the suspended ball will gradually lose its leverage power as it passes over the centre of the fulcrum of the lever to which the basin is attached; and conversely, as the basin rises so the ball gradually regains power in proportion to the length of the rod to which the ball is hung, and the distance of the ball from the centre or fulcrum.

In the preceding exemplifications of this part of Mr. Salter's invention, a chamber or recess projecting from the outside of the drain, is employed to contain the principal part of the flushing apparatus; but it will be obvious that the apparatus will act equally well if placed whollyinside of the drain,or any otherconduit or receptacle required to be emptied, instead of being placed wholly or partially outside of it; and there may be cases in which the placing of all or most of the parts of the flushing apparatus inside will be preferable to any other arrangement. In the application, for example, of this system of flushing to cesspools and waterclosets, the best mode of disposing of the different parts of the apparatus would probably be that represented in fig. 11 of the engravings.

The cesspool and water basin have been supposed to be fed from some public water works, or other remote source of supply; but they may also be readily connected to the ordinary water cistern of a house; and, by giving suitable dimensions to the apertures of supply and discharge in either case (which are easily calculated), the supply can be so adjusted as that the cesspool shall discharge itself once or twice in a week, or oftener, as may be deemed expedient. As the fluid matter rises in the cesspool, the ball, *a*, also rises till it reaches a point, when it opens the water cock, *g*, and admits water into the basin, *b*. Now as the basin, *b*, is fixed to the end of the lever, *c*, which has its fulcrum at c^a, and that lever is connected by a chain or rod to the plug at the bottom of the cistern, it follows, that on the descent of the basin, the plug, *e*, must be instantly and suddenly opened, when the contents of the cesspool will rush out with great velocity. But in order that the water in the basin may not be also wholly discharged on the instant (which would be injurious), the basin, *b*, is closed at top, and an aperture made in the top of it of such size that the water may take any given time desired to flow out of the basin. The weight, *d*, at the end of the connecting-rod, *c*, is merely used as a counterpoise to the basin, *b*, when empty.

An apparatus of the same kind as that last before described may be adapted to the ordinary water cistern of a house, and that connected by a pipe with the cesspool, so as to effect the like periodical discharge of the contents of the latter.

Figs. 11[a] and 12 show, in section and elevation, a flushing-gate, which is so constructed as to be self-acting. The parallel lines, *pp*, indicate the top and bottom of the sewer; *a* is the axial line, which is a little below the centre of the flap; and *b* is a chamber attached to the upper end of the flap. Supposing the water to be pent back on the side C, as soon as it rises above the axial line, *a*, it will counterbalance to a certain extent the weight of the water below that line, while the extra leverage requisite to raise the flap entirely, is obtained by the water flowing into the basins, *bb*, and the pent-up waters of the drain are thereby released. The basins then gradually empty themselves through holes, *tt;* and as the lower portion of the flap is the heavier, as soon as the basin becomes empty, the flap assumes again its original perpendicular position. To make the upper part of the flap quite water-tight, I propose to use gusset or packing pieces of gutta percha, or some other like waterproof material, attaching one piece to the edge of the flap, and the other to the frame, as indicated by the dotted lines in fig. 12. The dotted lines in fig. 11[a] show the line outside of the basins when two are used; and *tt* in both figures represent the holes through which the water is admitted into the basins.

In fig. 13 is given an elevation, and in fig. 14 a plan of a self-acting flushing-gate. *a* is the gate for damming back the water; *b*, a rod, having a joint at the centre, to which is attached or suspended a weight, *e*. One end of this rod may be fixed in the wall, and the other to some portion of the gate. When the water rises to the length of the pipe, *c*, it flows through that pipe into the basin, *d*. The basin, descending with the weight of water in it, raises the weight, *e*, which breaks or releases the joint in the rod which keeps the gate closed. The weight of water behind forces the gate open instantaneously, and raises the rod up into a triangular position. *f* is a latch, which is connected by a lever to the end of the lever of the basin, which lever works in a slot in the connecting rod, so that as the basin descends, the other end of the connecting rod rises in the slot, and allows the latch to drop, and fasten the gate back, that is to say, to keep it open. When the water flows out of the basin, the weight, *g*, at the opposite end, causes it to rise into its original position, while the descent of the end of the lever which has the weight, *g*, attached to it, raises the latch, and releases the gate. The principal part of the flushing apparatus is in this case supposed to be inclosed in the chamber used as the man-hole of the drain; but this, though preferable, is not absolutely necessary, as the apparatus will also work well if placed entirely within the drain.

Another modification of the self-discharging cistern is represented in fig. 15.

In this case, the discharge pipe is placed in a horizontal instead of a vertical position, and the valve or flap is hung with a joint instead of rising directly off its seat. The powerful effect which the *sudden* discharge of a cistern full of water must have in sweeping away the deposits of filth in a drain, will be at once apparent on inspection of the figure.

Mr. Salter intends having the outlet pipes, as well as the flap and basin, made of earthenware, which is considerably cheaper than cast-iron, and quite as durable. The cost of the whole apparatus will then be but trifling. The outlet pipe can be made of any size to fit or join into the earthenware drain pipes which are now being so generally adopted.

By Mr. Salter's plans, the drains are certain of being always cleansed thoroughly at least once a day, and in rainy weather much oftener.

Claims.—"*First.* I claim the attaching to carts for the distribution of liquid substances, of apparatus or machinery whereby the outflow is made dependent on the progression of the cart, and the width of space irrigated can be varied at pleasure, as before described.

"And, *Second,* I claim the attaching to drains, sewers, cesspools, and other like conduits and receptacles of apparatus or machinery whereby the same are rendered self-flushing, as before exemplified and described."

FRASER'S ELECTRO-MOTIVE ENGINE.—REPLY TO "F. F." BY MR. FRASER.

Sir,—I must plead my professional avocations as an excuse for the delay which has occurred in my reply to "F. F.'s" last letter. I now, however, beg, in the first place, to relieve his mind of the apprehension which he entertains, that I am spending my time and money on what he believes to be an impracticable scheme. Such an imputation no canny Scotchman would willingly lie under; and I can assure him, that less than twenty shillings of money, and a few inconsiderable odds and ends of leisure, are all that have been expended in the completion of what has been, in your pages, magniloquently termed—"Fraser's Electro-magnetic Engine." The sum mentioned, however, of course, does not include the cost of a battery, nor of a wire-covering machine, which were previously in my possession.

In applying the term *theoretical results* to "F. F.'s" calculation of the working power of an electro-magnetic machine on the rotary principle, I simply meant, that as the assumed data were, to a certain extent, theoretical, and not practically well-understood facts (such as the area of a steam piston, and the pressure of steam bearing upon it), the results must be so likewise. I believe that the magnets are not found, when arranged on the periphery of a wheel, as described by "F. F.," to exert the combined force which one might at first anticipate,—a discrepancy the causes of which are hinted at in my last letter. Nor would it be possible to attain a *working* speed of 300 revolutions per minute. I have the authority of Mr. Robert Davidson, of Aberdeen (a gentleman who, I believe, has had more practical experience on this subject than any other person in this country), for saying, that when an electro-motive machine is performing work, and not merely acting without any other resistance than that afforded by its own parts, *two hundred changes of direction of the current per minute, forms the utmost limit of velocity that can be attained without causing a corresponding loss of power.*

This circumstance, which, of course, precludes all hope of attaining success by increasing the velocity beyond a certain limit, will very much alter the calculation made by "F. F." at the commencement of his first letter. In the twelve-magnet rotary machine, which he contrasts with a column of 96 magnets of the same size, arranged according to my method, six changes of direction of the current would, I believe, be necessary for each revolution; which would give 33 rotations per minute, instead of 300, which he takes for granted. This would reduce the effect produced from the raising of 225 lbs. to that of 27¾ lbs. through one foot per minute. Multiplying this by 8, to bring it to the ratio of 96 magnets, would give 222¼ lbs. through one foot per minute, which is very little more than the effect (200 lbs.) he attributes to the columnar machine when vibrating at the rate of only 150 (instead of 200) changes of current per minute.

"F. F." cannot coincide with me in thinking that any advantage is to be gained by an imitation of nature, and recommends me to relinquish the supposed analogy between the muscular and electro-magnetic actions. Now I confess that these are, in my opinion, the only valuable features in my model; and such is my belief in the strength of the analogy in question, and my faith in the wisdom and perfection of the arrangements which God has displayed in all his works (not the least of which is our own constitution, both mental and corporeal), that I feel persuaded the readiest and most likely way of overcoming the difficulties in our path, and arriving at a satisfactory termination, will be by making the study of that department of nature which bears most analogy to the subject one of our chief guides, though by no means neglecting the other lights which science affords. "F. F." may, however, if of a different mental constitution, not be disposed to admit of an argument of this kind, dependent, as it is, on the comparative strength of a feeling, in reasoning on a mechanical subject. Instances must occur to most of your readers of some of those admirable mechanical arrangements existing in the human body, which have afforded models, or might have done so, for some of the most useful and ingenious machines employed in the service of mankind.

In regard to the disputed point, of the accumulation of galvanism in batteries, I

am satisfied that this does take place in some kinds of battery. In the one which I have been using, viz., Smee's, it seems to attain its maximum of accumulation in about half a second. I have frequently observed, when experimenting with my machine, that when the contact is renewed at such intervals, a more vigorous effort is produced—a heavier weight is lifted, than when it is made at shorter intervals, or continued for a time unbroken. The argument to be deduced from this fact, if it be admitted as such, in favour of a *comparatively* slow motion, is too obvious to require to be dwelt upon.

To prove that the principle on which my plan is based, is incapable, by any adaptation whatever, of successful practical application, "F. F." shows its inconsistency with certain desiderata which he lays down as indispensable in electromotion. These desiderata, or at all events, the first two of them, namely, "the smallest possible number of magnets moving with the greatest possible speed," I believe to be perfectly gratuitous, and consequently that the desiderated condemnation is a *non-sequitur*.

The desiderata that I should, on the other hand, venture to lay down, would be—1st. The *direct and complete action* of the magnets; 2nd. The means of producing in the magnets themselves such an extent of *primary motion or stroke*, as to be at once capable of effective transference to the subordinate machinery; 3rd. Simplicity and economy in the mechanism itself; and, 4th. A sufficiently powerful and cheap battery.

Tried by this standard, though my machine does not fulfil every requisite, yet as it possesses some of them to a greater extent than any other electromotive apparatus (so far as I am aware). and may, in the hands of practical men be made to fulfil the whole, it humbly appears to me that it does not merit the sweeping condemnation which "F. F." has bestowed upon it.

Although the appearance of egotism, which self-defence obliges me to assume, is far from agreeable, I shall have no scruple in replying to the unbiassed and truth-seeking strictures which "F. F.," or any other correspondent, may think proper to make; that is, provided you, Mr. Editor, should continue to think the subject worthy of a place in your columns. At the same time, it is right to mention, that I brought the matter forward, in the first instance, as a physiological curiosity—a piece of mechanism constructed after the most recent and accurate delineations of the microscopic appearance of the muscles which could be made by an artificial stimulus to imitate the functions of those organs.

I am, Sir, yours, &c.,

Wm. Fraser.

Aberdeen, November 28, 1848.

GLASS TUBES.

Sir,—In reply to the question which appeared in your Number of the 4th ult., in reference to the mode of joining glass pipes, I beg to inform you that the Bristol and Nailsea Glass Company prepare a cement for the purpose, with instructions for its use. The pipe-ends being of equal diameter, they are abutted together, and the cement applied in a melted state, and finished similar to a plumber's joint on a leaden pipe. The cement is cheap and effective, resisting the action of all cold fluids and gases, either acid or alkaline.

I am, Sir, yours, &c.,

Henry Malcolm.

Bristol, November 23, 1848.

THE ELECTRIC LIGHT.

This light, of late so much talked of, was exhibited to the public last night (Wednesday), between the hours of eight and nine o'clock, from the portico of the National Gallery. A better site for such an experiment could not have been selected, and the novelty of the exhibition soon attracted to the spot a large assemblage of spectators, who filled the street and terrace opposite the gallery, as well as a great portion of the square below. The moment the experiment commenced, the large open space in front was filled with a flood of light, which paled the lamps, not only in the square, but also some distance down Whitehall. So intense was it, that, when thrown upon the people, one could scan the countenances of those who were most distant from the gallery, and discern the cut of a man's coat or the pattern of a lady's dress at the outskirts of the crowd. Every now and then a strong pencil of light would be thrown upon the Nelson column, bringing it out from the surrounding obscurity, from its base to its summit. The light was as steady as it was intense, and the shadows which it cast were as deep and positive as those which accompany the

strongest sunlight. On the whole, the experiment appeared to be successful in the hands of the operator, and satisfactory to all who witnessed it.—*Morning Chronicle.* —[We witnessed another most brilliant exhibition of the light last night (Thursday) at the same place.—Ed. M. M.]

THE LADY'S AND GENTLEMAN'S DIARY FOR 1849.

Sir,—Permit me, through the medium of your valuable journal, to request the readers of the "Lady's and Gentleman's Diary" to correct a slight error which I observe in the number for 1849, which has just appeared.

Page 86, line 15 from bottom, for

$$\frac{(u_1, {}_2)}{(u^2, {}_2)},$$

read

$$c.\frac{(u_1, {}_2)}{(u_2, {}_2)}.$$

It may be useful to the junior readers of the Diary to observe that the constant c, which my argument does not require me to particularise, is independent of the co-ordinates of the point from which the perpendiculars are supposed to be drawn, and is of the form

$$\frac{\sqrt{a^2 + Aa + 1}}{\sqrt{a_1^2 + Aa_1 + 1}}.$$

I am, Sir, yours, &c.,

Thos. P. Kirkman.

Croft Rectory, near Warrington,
November 25, 1848.

SPECIFICATIONS OF ENGLISH PATENTS ENROLLED BETWEEN THE 25TH OF NOVEMBER, AND 2ND OF DECEMBER, 1848.

Thomas Richardson, Newcastle-upon-Tyne, Chemist. *For improvements in the manufacture of manure.* Patent dated May 26, 1848; specification enrolled November 25, 1848.

These improvements consist in dissolving or decomposing animal matters, such as bones or guano, containing phosphates of lime and magnesia, in the liquor of alum works, known as "mother salts," or in a solution of rough Epsom salts, such matters being mixed with a small proportion of either nitrate of potash, soda, lime, or magnesia, or nitric acid. The mode of operating is as follows:—The animal matters are placed in an iron vessel, lined with strong sheet lead, and mixed with one of the nitrates, or with nitric acid, and mother or rough Epsom salts in the proportion of bones or guano containing 75 lbs. of the phosphates, to 100 gallons of mother salts, or 300 lbs. of rough Epsom, dissolved in the smallest quantity of water possible. The proportion of the nitrate or nitric acid to the phosphates is to be as 1 to 26, when bones are used, and only half that quantity when guano. The mixture is then boiled until the animal matters disappear, and it attains the consistency of paste. It is then removed and dried by subjection to a heat not exceeding 300° Fahr., lest the animal matters should be injured; after which it is reduced, to powder and applied in the ordinary way as manure. The bones are to be ground up between edge stones in the first instance; and, in order to economise fuel, rough Epsom salts may be mixed with the mother salts in the proportion of 3 lbs. of the former to one gallon of the latter.

Claim.—The employment of mother salts, or rough Epsom salts in solution, separately or combined, and in conjunction with either nitrate of soda, or nitrate of potash, or nitrate of lime, or nitrate of magnesia, or nitric acid, to dissolve or decompose animal matters containing phosphates of lime and magnesia.

Moses Poole, London, Gentleman, *For improvements in propelling vessels.* Patent dated May 26, 1848; specification enrolled November 25, 1848. (Communicated from Lieut.-Col. Sir T. Levingston Mitchell.)

This invention consists in the application of a screw constructed on the principle of the "Boomarang," and placed in a suitable axial position, to the propelling of vessels. On observing the motion of the boomarang in the air, whirling round a hollow centre and leaving a vacant centre of gravity, it occurred to Lieut.-Col. Sir T. Levingston Mitchell that its centre of motion would be found to be on a right line, which would divide the boomarang into three portions, in such manner as that the eccentric portions should equal the central one; and this, Lieut.-Col. Mitchell subsequently proved to be the case. The bearing of the boomarang screw in which the rotary shaft fits, is consequently to be placed in this newly-discovered centre of motion, and suitably attached. The advantages of this form of screw are stated to consist in its working in the water obliquely to the radius of rotary motion, and being free from lateral pressure.

Claim. — The employment of screw propellers of the "peculiar character described."

[We make no doubt that the idea of this propeller is new to Colonel Mitchell, but if the reader will refer to the *Mech. Mag.*, vol. xli. pp. 238, 256, 268; vol. xlii. p. 234; vol. xlix. p. 130; he will perceive that it is identical with the parabolic propeller patented two or three years ago by Mr. Hodgson, and repeatedly tried with great success.]

Abraham Solomons, London, Merchant, and Bondy Azulay, Rotherhithe, Surrey, Printer. *For improvements in the manufacture of gas, tar, charcoal and certain*

acids. Patent dated May 26, 1848; specification enrolled November 25, 1848.

These improvements refer to the destructive distillation, or carbonization, in close vessels, of wood, peat, turf, refuse of dyewoods, and other vegetable matters, by means of steam of high temperature, whereby gas, tar, charcoal, (of any required degree of carbonization) and pyroligneous and acetic acids are produced.

The apparatus employed consists of a strong cast or wrought iron cylinder, firmly imbedded in masonry, which encloses a cylinder of the same kind that is kept at a convenient distance from the interior circumference of the outer cylinder, by suitable iron stays. The inner cylinder contains a casing of sheet iron within which the wood to be carbonized is placed. The outer cylinder is heated by a furnace, placed underneath, in the flue of which is coiled the steam induction-pipe, so that the heat in its passage to the chimney may be partially imparted to the steam which is admitted from a boiler, through the coil of pipes, into the outer cylinder, whence it passes into the inner cylinder, and to the wood contained in the casing. The liquid and gaseous products are allowed to escape into the air or into suitable refrigerators, and manufactured by well-known means, into gas, tar or acids.

When sawdust, refuse of dye-woods, &c., are to be operated upon, they are placed in several cylinders of comparatively small diameter, which are placed inside the inner cylinder and treated as before described. Or they may be moulded into any desired shape under pressure, with or without admixture with any other substance, and then submitted to the process of destructive distillation or carbonization. Or they may be placed in cylinders in an ordinary retort, and subjected to the common process.

Claim.—The production of gas, tar, charcoal, and pyroligneous and acetic acids by destructive distillation or carbonization, through the agency of steam of high temperature.

GEORGE REMINGTON, Warkworth, Northumberland, C.E. *For improvements in locomotive engines, and in marine and stationary engines.* Patent dated May 26, 1848; specification enrolled November 25, 1848.

These improvements consist, 1st, in converting reciprocating rectilineal motion into rotary motion. 2nd. In converting rotary motion into reciprocating rectilineal motion. And, 3rd., in a mechanical arrangement for reversing the action of engines.

1. Upon the revolving shaft is fixed, at right angles, a lever, to the other end of which, and on one side is attached a small rectangular block. On that side of the lever which carries the block is a square metal plate containing two slots, one horizontal and the other vertical, and intersecting each other at right angles in the centre of the plate. The revolving shaft passes through the vertical slot, so that the plate may travel freely up and down over it. The block (which is somewhat longer than the breadth of the vertical slot) is placed in the horizontal slot. Supposing the lever to be upright, slightly deviating from the perpendicular which is parallel to the vertical slot, and that a downward motion is communicated from a steam-engine to the plate, to the full extent of the vertical slot; the result will be that the block will travel from the centre to the end of the horizontal slot, that the lever will assume a position the reverse of the one in which it was first placed, and that the main shaft will have made one half of an entire revolution. The dead centre is then overcome by a fly-wheel, and an upward motion given to the plate, whereby the revolution of the main shaft is completed, and the lever brought back to the first position ready for the second operation.

2. The arrangements for converting rotary motion into reciprocating rectilinear motion are the reverse of those just described. Where the rotary motion is to be communicated to the end of a crank-shaft or crank-pin upon a wheel, the vertical slot may, it is said, be dispensed with, and the horizontal one only used, or a groove may be substituted for the slot.

3. The apparatus for reversing the engine would scarcely be intelligible without drawings.

Claims.—1st. The application to locomotive, marine, and stationary engines of the mechanical principle (involved in the arrangements 1 and 2) before described, with the exception in the case where a one-slotted or grooved plate is used, and then only when working inside the cylinder.

2nd. The apparatus for reversing the engine as described and exemplified in the drawings.

GEORGE HENRY BURSILL, Hornsey-road, and JAMES PATERSON, City-road, and JOHN MATHEWS, Old-street, Middlesex, Engineers. *For a certain improved method or methods of treating malt liquors and other liquids or fluids, and certain improvements in machinery or apparatus for effecting such improved method or methods of treatment.* Patent dated May 22, 1848; specification enrolled November 22, 1848.*

The invention which forms the subject of this patent consists in impregnating malt li-

* Omitted in our abstracts last week, in consequence of the patent itself having been omitted in the published lists of patents.

quids, and other fluids with carbonic acid gas in small quantities, and as they are required for consumption, which is effected while in the act of forcing or lifting the liquid by a suitable arrangement whereby a proportionate quantity of carbonic acid gas is drawn from the gasometer at the same time as the liquor is drawn from the beer barrel, and caused to mingle with it in the barrel of the pump.

Claims.—The impregnating of liquids with carbonic acid gas in small quantities, and as they are required for consumption, and the machinery, described in the specification, or any other suitable apparatus for effecting the same.

James Parker Penny, Clarendon-place, Notting-hill, gentleman. *For certain improvements in obtaining copper from copper ores.* Patent dated May 26, 1848; specification enrolled November 25, 1848.

These improvements consist in decomposing the carbonates and oxides of copper ores by leaves, chips of wood, charcoal, or other similar carbonaceous matters, during the process of smelting. The furnaces employed are of the ordinary melting and reverbertory kind used in Swansea and Holywell, differing only in this, that the crown is brought in closer proximity with the bottom in order to keep the flame and heat down upon the mass; and that the furnace is made larger to admit of the employment of wood as the fuel. The furnace being heated to white heat, the copper ore, previously broken into pieces, is introduced through the crown, and when fused a sufficient quantity of leaves, wood chips, charcoal or other similar carbonaceous matter is thrown in upon it. Or the copper ore may be reduced to powder and mixed with the carbonaceous matter prior to its introduction into the furnace. The copper, when separated from its compounds, is received into a cavity in the furnace; after which it is tapped and run out into moulds in the usual way.

Claim.—The decomposing the carbonates and oxides of copper ores by means of leaves, chips of wood, charcoal, or other similar carbonaceous matters during the smelting process.

Matthew Hague, Waterhead-mills, Lancashire, machine-maker, and Joseph Firth, Huddersfield, cotton doubler. *For certain improvements in machinery for twisting and doubling cotton yarns, and other fibrous materials.* Patent dated May 26, 1848; specification enrolled November 25, 1848.

These improvements refer to twisting or twining jennies, and consist in combining the carriage, headstock, and spindles with certain mechanical arrangements in such manner that they shall perform, without the aid of manual power, these seven operations, namely:

1st. The "running out" of the carriage, whereby a continuous supply of mule or throstle yarn is delivered to the spindles.

2nd. The rotation of the spindles.

3rd. The "stripping off," whereby the rotation of the spindles is momentarily checked, and a small portion of the twisted yarn lifted off their stems, simultaneously with which the

4th operation, or "faller movement," as it is termed, takes place. By which the delivery of the twisted yarn upon the spindles is regulated.

5th. The "putting up" of the carriage.

6th. The "winding on," whereby the twisted yarn is wound upon the spindles in successive coils at a differential speed proportionate to the varying size of the cop.

7th. The "cop or shaper movement" whereby the cop is built up in an uniform and proper shape upon all the spindles simultaneously.

Claims.—1. Effectuating the rotation of the fast motion shaft uniformly in one direction, whereby any back lash or shock to the working parts of the machinery is avoided.

2. The mode of running out the carriage by means of a scroll wheel and endless band, thereby dispensing with the use of racks and straps ordinarily employed for that purpose.

3. The putting up the carriage by reversing the action of the scroll wheel, &c.

4. The faller movement.

5. The mode of winding on the yarn at a varying speed by means of a leather friction cone and lever acting upon the rim pulleys and endless bands.

6. The cop motion.

7. The systematic mechanical arrangement, or any modifications of them, or their equivalents, whereby the machinery is made to perform the required operation independently of manual power.

William Seaton, Camden-town, Middlesex, gentleman. *For improvements in closing tubes, and in preventing and removing the incrustation in boilers.* Patent datent May 30, 1848; specification enrolled November 30, 1848.

These improvements consist,

1. In closing the ends of the tubes of steam boilers and steam generators, so as to make them round and hemispherical. When the tubes are of iron they are heated to a welding heat, and placed on a vertical iron or steel mandril, with the end to be closed projecting slightly beyond it, and sub-

mitted to the action of a suitably formed die under pressure. When the tubes are of copper, or of any alloy of that metal, they are submitted to the same process, with the exception of heating, and as the end cannot be perfectly closed, a small hole is left or made in it which is afterwards closed by a rivet of the same metal in the usual way.

2. In removing and preventing incrustations in steam boilers and generators, by precipitating the lime (of which they are generally formed), by oxalic acid, or carbonate of potash, or carbonate of soda, or other chemical agents, in a tank, and filtering it through charcoal and sand; that is to say, when there is not sufficient time to allow of the precipitation preparatory to the admission of the water into the steam boiler or generator. Or, in employing chemical agents, such as nitric, muriatic, or acetic acid, &c., to hold the lime in solution, and enable it to be blown off from time to time. Or, in using in the steam boiler or generator, sawdust or charcoal, which, by its mechanical action, prevents the formation of deposits. When operating on salt water, salt, soda, or saltwort is used. The relative quantities of the chemical agents to be employed, are to be determined by a previous analysis of the water; and to remove any incrustation which may have been formed *à priori*, an excess of the chemical agent employed must be used.

Claims.—1. The closing the ends of the tubes of steam boilers and generators by dies, as described.

2. The mode of preventing and removing the incrustations in steam boilers and generators, as described.

William Wood, Cranmer-place, Waterloo-road, Surrey, carpet manufacturer. *For improvements in weaving carpets, and in printing carpets and other fabrics.* Patent dated May 30, 1848; specification enrolled November 30, 1848.

The patentee remarks, that in weaving hollow looped carpets, or pile-cut fabrics generally, which are printed in the warp or afterwards, only sufficient woollen material to form the loop is used, and that linen yarn being the material of which the remainder of the fabric is composed, it is deficient in substance, elasticity, and warmth. His invention, therefore, consists, *firstly*, in giving additional substance, or thickening, or "dead," as it is termed, to the fabric, by employing another weft of a thicker kind at the back or in the body of it. *Secondly*. In order to overcome the obstacle which has hitherto prevented the more general application of mechanical printing to hollow looped and pile-cut fabrics, and which consists in the difficulty of imparting sufficient colour, and results from not being able to pass the printing cylinder exactly over the same parts, he adopts the following mechanical arrangement. Above the printing-table on which the fabric is kept distended, are placed, longitudinally, guide rails, on which travels to and fro the printing frame, which carries the printing cylinders, having the pattern engraved or formed on their peripheries, together with the colour can and distributing rollers. On the axes of these cylinders are keyed toothed wheels, which gear into toothed racks made fast to the guide rails, so as to ensure the cylinders passing over the same portions of the fabric as the frame travels to and fro, and whereby any amount of colour may be imparted to it.

Claim 1.—The mode of manufacturing hollow looped carpets, and pile cut fabrics, woven with printed yarns, or coloured or plain, and afterwards to be printed, with additional weft, as described.

2. The printing of these fabrics by means of cylinders, or rollers, actuated or controlled so as to ensure the pattern passing over the same portions of the fabrics.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Pierre Armand Lecomte de Fontainemoreau, of Skinner's-place, Size-lane, for certain improvements in the process of and apparatus for treating fatty bodies, and in the application of the products thereof to various useful purposes. (Being a communication.) November 25; six months.

John Goucher, of Woodsetts, in the West Riding of the County of York, agricultural machine maker, for a machine for thrashing corn and other grain. November 25; six months.

John Lane, of Liverpool, and John Taylor, of Liverpool, engineers, for improvements in engines, boilers, and pumps in rotary carriages, in propelling vessels, in the construction of boats, in extinguishing fire, and in brewing. November 29; six months.

Edward Schunck, of Rochdale, Lancashire, chemist, for improvements in the manufacture of malleable iron, and in treating other products obtained in the process. November 26; six months.

William Rothwell Lomax, of Banbury, Oxford, engineer, for improvements in machines for cutting hay and straw into chaff, and for cutting other vegetable substances. November 29; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Nov. 23	1676	Charles Rowley	Birmingham	Ticket holder.
,,	1677	John Ferrabee and Son,	Stroud, Gloucestershire	Knife, with guard, for cutting vegetables and other substances.
,,	1678	Joseph Ashforth & Co.,	Sheffield	Ratchet wrench or spanner.
,,	1679	William Tortoise	John's street, Clerkenwell	Paper cutting slide.
24	1680	Thomas Evans	Southampton-street, Strand	Expanding shirt collar.
,,	1681	Henry Browne	Walworth	A bath cock.
,,	1682	Frederick Allen	Birmingham	Brooch fastening.
,,	1683	Jarrold and Sons	St. Paul's Churchyard, London,	Juvenile artists' drawing table.
25	1684	John Gilby	Chelmsford	Reins for driving or riding.
,,	1685	The Broomsgrove Railway Carriage Company	Broomsgrove	Pipe joint and fastening.
27	1686	Haldane and Roe	Edinburgh	Tap or cock for drawing off liquids.
,,	1687	John Petrie	Rochdale	Wringing and mangling machine.
,,	1688	T. and W. Roberson	Ardrossan	Pentagraphic delineator.
30	1689	Clarke & Timmins	Birmingham	Music stool, screw tube, and box.

NOTICES TO CORRESPONDENTS.

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Edited by J. C. Robertson, 166, Fleet-street.

MR. HENRY ADCOCK'S PATENT IMPROVEMENTS IN FURNACES AND FIRE-PLACES.

Fig. 1.

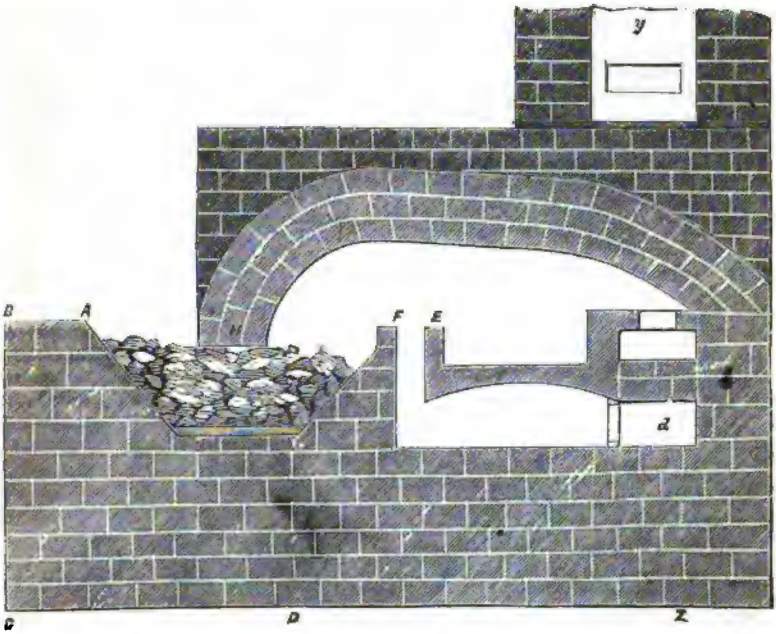
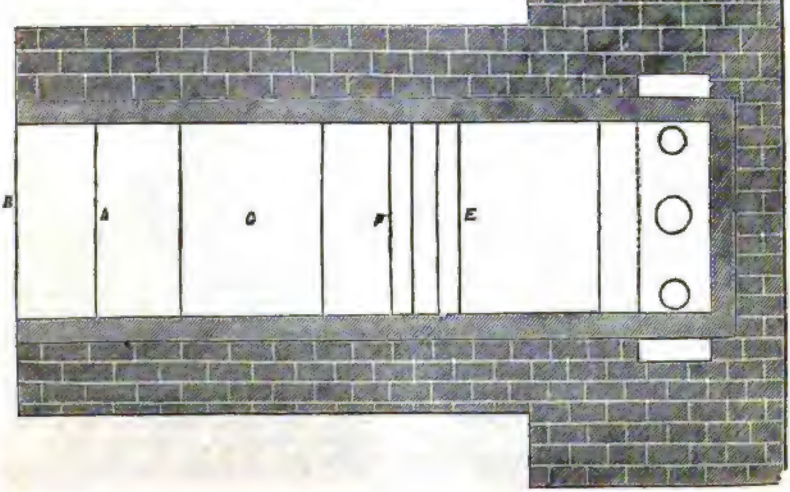


Fig. 2.



MR. HENRY ADCOCK'S PATENT IMPROVEMENTS IN FURNACES AND FIRE-PLACES.

[Patent dated June 3, 1848. Specification enrolled December 2, 1848.]

Mr. Adcock prefaces the description of his present invention with the following remarks:—

"In furnaces and fire-places, as usually constructed, there are a series of fire-bars, on which the coal is laid, and there is generally a considerable space from such coal to the upper part of the furnace, so that a stream of cold air entering through the fire-doors is constantly flowing into the furnace, and, by commixing with the heat, reduces the temperature. The interstices of the fire-bars also, when not properly covered with fuel, admit cold atmospheric air into the furnace, to a similar prejudicial extent. The quantity of heat thus abstracted from a furnace, and carried off through the flue of a chimney, is enormously great. In a flue of a steam-engine boiler chimney 4½ feet square, the area is 20¼ feet; and, taking the draught at 12 feet per second, the quantity of heated air thus evolved is 243 cubic feet per second, 14,580 cubic feet per minute, 874,800 cubic feet per hour; and it is not unusual to see flame escape from the top of chimneys, both stationary and belonging to steam-boats. Now, I propose to have no fire-bars, but to put the coal or coke, or other fuel, into a hopper, to ignite the same, and to keep the upper part of that hopper well supplied with what is usually called "*green coal*"—that is, coal in an unignited state. By such arrangement, the atmospheric air can only get into the furnace by passing through the interstices of the "*green coal*," and thence through the heated mass; and the rapidity of its passage will be regulated by the conical damper aforesaid. Furnaces of somewhat similar construction, as regards the downward draught of the air, have been used before. But, in consequence of their not having a proper regulating damper, the heat has been so intense as rapidly to destroy the furnace and steam-engine boilers exposed to its action.

"Further, with a view to the economization of fuel, I propose in all kinds of reverberatory and air furnaces, to have a double crown or arch to the top of the furnace, with a stratum of air confined between them, by which means much of the heat which is now evolved from the top of the furnace will be economized, and the furnace, most probably, will be of longer duration. In furnaces of glass works, he proposes to take the heat and flame from a hopper, as aforesaid, on to the top of the pots or crucibles which hold the glass to be melted, thence to conduct such heat and flame and heated air through longitudinal apertures on both sides of such pots or crucibles, into flues below the furnace, and thence into a chimney having a regulating damper, as before described."

Mr. Adcock's invention, therefore, consists, 1. In preventing the ingress of cold air into the body of a furnace; 2. In maintaining, by means of a conical or other correspondingly-shaped damper, a reservoir of heat; and, 3. In preventing, by means of a double-arched top, a wasteful evolution of heat into the atmosphere.

Mr. Adcock proceeds to give illustrated descriptions of nine different sorts of furnaces and fire-places, to which he considers his improvements to be applicable. We select from these the melting furnace, represented in the prefixed engravings, as best showing the general system of construction adopted by Mr. Adcock.

Fig. 1 is a longitudinal section of this furnace, and fig. 2 a plan. A is the hopper (*fire-box* would have been perhaps a more appropriate name), which is divided for a little distance from the top, into two compartments by the dipping down into it of the crown of the furnace. When it is filled with coal, the ignited portions occupy the compartment on the inside of the crown partition, and the green or unignited portions that on the outside; and the atmospheric air necessary for combustion, can only find its way into the interior down through the green coal. The draught from the hopper is divided into two portions, one of which passes along the reverberatory arch to the chimney, and the other takes a downward course into a flue, *d e f*, whence it escapes into the chimney.

Neither the double arch nor the conical damper is represented in the figures. The "additions necessary to be made for the former," are stated to be "such as "will be readily understood by any

competent workman," subject to this remark only, that the patentee "prefers, in all cases, to leave an air space of from four to six inches between the top of the furnace and the additional crown." The conical damper is simply a cone suspended over the top of the chimney from a weighted lever, and let down into it, more or less, as required, by a chain attached to the end of the lever.

In the case of locomotive engines, Mr. Adcock adopts the usual fire-box, but divides it by a hopper filled with water.

Claims.

"*First*, I claim the constructing of furnaces and fire-places with a feed-hopper divided for a short way from the top, into two compartments, through the outer of which alone the atmospheric air necessary to combustion can obtain access, and with a conical or other correspondingly shaped damper, by which a too rapid draught through the chimney is prevented, and a constant reservoir of heat is maintained in the interior, all as exemplified in the drawings hereto annexed and before described.

"*Second*, I claim the employment in furnaces and fire-places of a double crown or arch with a stratum of air confined between them as before described.

"And, *third*, I claim the dividing of the fire-box in locomotive steam-engines transversely into two parts by a hollow metallic partition or hopper filled with water, as before described."

HORÆ ALGEBRAICÆ. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

(Continued from p. 521.)

X. HISTORY.

The Theory of Congeneric Surd Equations has occupied us during a considerable portion of these *Horæ*. It appears to me that there are, in the development of that Theory, several distinct periods possessing characteristics sufficiently well marked to deserve separate discussion. Moreover, I am of opinion that, in the history of the subject, no little confusion is likely to arise from a neglect of this discussion, and I am, consequently, induced to offer the following observations on Congeneric Surd Equations and on a kindred subject—that of Impossible Equations.

(1). I am inclined to think, but I offer the opinion with great hesitation, that the existence of impossible equations has been known for many ages. Or, if *known* should seem too strong a word, I will state some circumstances which tend to indicate that the existence of such equations was at least *suspected* by those philosophers—whether Caucasian or Mongolian, Indo-German or Indian, or other, is not now the question—by those philosophers whose labours are preserved to us in the *Lilavati*, the *Vija-ganita*, and the remaining records of ancient Oriental Science. Of these circumstances, one is afforded by the first Example of a quadratic equation which occurs in the *Vija-ganita*. That example is as follows:*

"The square-root of half the number of a swarm of bees is gone to a shrub of jasmin; and so are eight-ninths of the whole swarm: a female is buzzing to one remaining male, that is humming within a lotus, in which he is confined, having been allured to it by its fragrance at night. Say, lovely woman, the number of bees."

To solve this problem we are directed to "Put the number of the swarm of bees *ya*, *v*, 2."† In this expression *ya* is an abbreviation of *yavat-tavat* of which the literal signification is "So much as," and of which the meaning is *an unknown quantity*;‡ *v* indicates that *ya* is to be squared;§ and 2 that twice the square is to be taken.‖ In modern notation this assumption would be represented by $2x^2$; but, the *quæsitum* of the problem being the number of bees in the swarm, why was not *ya*,1 (or x) taken to represent that number? It was not to avoid

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* See pp. 211—2 of "Algebra, with Arithmetic and Mensuration, from the Sanscrit of Brahmegupta and Bhascara. Translated by Henry Thomas Colebrooke, Esq., F.R.S.," &c., &c., &c. London, Murray, 1817. See also p. 31 of Mr. COLEBROOKE's admirable work just mentioned, and BRIDGE's Algebra (6th ed.) pp. 98—99. Compare the enunciation in the latter excellent work with that here given.

† *Ibid.*, p. 212, art. 132. In the above expression for the number of the swarm, and also elsewhere, I have inserted commas for the purpose of avoiding mistakes in printing.

‡ *Ibid.*, p. 185.

§ *Ibid.*, p. 141, note 2. Mr. COLEBROOKE writes *v* for *va*, as he does *c* for *ca* in the notation for surds (*Ib.* p. 145, note 1.)

‖ The coefficient follows the number, as we might expect, for, as we are informed by Mr. COLEBROOKE (*Ib.* p. 139, note 1), "*Yavat* is relative of the unknown; and *tavat* of its coefficient." So that the coefficient is the consequent.

fractions, because, with that assumption, fractions occur in the statement of the question, and, moreover, such a purpose would only account for the occurrence of the co-efficient 2. As little was that assumption a capricious or accidental one as we may see from the next Example in the *Vija-ganita*,* which is:—

"The son of PRITHA, exasperated in combat, shot a quiver of arrows to slay CARNA. With half his arrows he parried those of his antagonist; with four times the square root of the quiver-full, he killed his horse; with six arrows he slew SALYA; with three he demolished the umbrella, standard and bow; and with one he cut off the head of the foe. How many were the arrows that ARJUNA let fly?"

The instructions which follow† are: "In this case put the number of the whole of the arrows *ya, v,*1." In other words assume that number to be x^2. But, why not x? In this instance there appears to be but one answer for the Oriental investigator to give, viz.: *we must avoid surds*. And this answer explains the peculiar form of the assumption in the first Example. Had x^2 been assumed, as the total number of bees, we should have had the surd $\sqrt{2}$ introduced into the expression of the problem. But, why object to the introduction of surds? It was not that the Orientals did not recognize surds, on the contrary, their knowledge of their properties was extensive and accurate.‡ It was not that they had not a convenient notation, for, such a surd number as $\sqrt{2}$ would be denoted by *ca* 2, or (adopting Mr. COLEBROOKE's variation) by *c* 2; and, if we say with NARAYANA§ that "A quantity, the root of which is to be taken, is named *Carani*," I cannot see why *ca* or *c* should not have been applied to *ya* thus, *c, ya*. This quantity would have corresponded to our $\sqrt{x}$. The solution of the problem would then have been effected by our supposing the sum of *ya*, ½ and *c, ya*, 4 and *ru*, 10 to be equal to *ya*, 1; and we should thence arrive at

$$\left[\begin{array}{ll} c,\ ya,\ 1 & ru,\ \dot{4} \\ ,\ ya,\ 0 & ru,\ 6 \end{array}\right]$$

whence we obtain 100 as the value of *ya*, and the further advantage that *yavattavat* is the very *quæsitum* of the problem, the number of arrows. But, even if we suppose the word *Carani* to be applied exclusively to *number*, those who achieved, in notation, the results which we see in the *Vija-ganita* would not have had much difficulty in expressing the square root of *ya*. Is it improbable, then, that the avoidance of surds, which, as we have seen, takes place in the above examples, became a rule of proceeding, in consequence of the contradictory results to which surd equations sometimes lead us? BHASCARA was aware of the double sign which attaches to a square root,* and has used that double sign to obtain two positive roots of a quadratic,† and, I believe, that he also admitted, in all cases, two roots of a quadratic, for, we see him‡ squaring a negative quantity, considered by itself, without reference to other quantities; and, further, when we see him rejecting the root 5 because it is "incongruous,"§ he qualifies the rejection by, as I presume, assigning as a ground, that "people do not approve negative absolute number,"‖ and negative quantities are by means of this root 5, introduced into the conditions of the question. Now, suppose for a moment, that, in the first attempts at the solution of the two problems given above, the *quæsitum* had been taken as *ya*, then the algebraist would have had, in the first example, 72 and $\frac{9}{4}$ and in the second 100 and 4, as the values of *ya*. It would have been seen (for, as in other cases,¶ both values would certainly have been tried) that the second value would in neither case satisfy the required conditions. I think it also highly probable that the *reason* of the failure would have been seen, as the double value of the radical in the enunciation would naturally offer itself as a mode of explanation. The question then is, whether *ya* was originally taken as the *quæsitum*

* COLEBROOKE, p. 212, art. 133; and pp. 30—1.
† *Ib.* p. 212. ‡ *Ibid.* pp. 145—155.
§ Cited by SUR. See COLEBROOKE, p. 145, note 1. The definition of NARAYANA is more comprehensive than those of CRISHN and GAN as given in that note.

* *Ibid*, p. 135.
† *Ibid*, p. 216.
‡ *Ibid*, p. 135.
§ *Ibid*, p. 217.
‖ This passage is quoted at p. 324, of vol. xxvi. of the *Penny Cyclopædia* by the learned author of the article VIGA GANITA. I shall on a future occasion remark on the opinions of the commentators.
¶ COLEBROOKE, pp. 217—8.

in those examples, and I confess that I cannot help seeing, in the introduction of square roots into the enunciation of the first two examples of quadratic equations, and in the assumption that *ya* is something other than the *quæsitum*, a marked desire to overcome a natural tendency to make such assumption—a tendency which the writer had found to lead to error. Add to this, that if the writer had considered the error in question as a mere "incongruity," he would probably have noticed it as such, as he has done other "incongruities" further on,* but perhaps he felt that he could not call that an "incongruity" which was in fact a solution of the congeneric surd equation corresponding to the given one. Lastly, let me observe, that we can hardly suppose that inquiry was directed to the two examples given above, and only to them. And the discovery of one surd equation without any root would account for the studious avoidance of surd formulæ which we see in the above portion of the *Vija-ganita*—a magnificent work, which would be more generally studied, did the history of science hold the position which it deserves in the estimation of the learned.

(2). In Problem XXVI. of his *Meditationes Algebraicæ*† (Camb. 1782), WARING has given a general method for clearing a surd expression from radicals. He does so by taking the product of all the various values, which the expression may be made to take by applying all the appropriate roots of unity to each of the different radicals, and considers the subject of the reduction of surd to rational equations. But, as intimated by HORNER,‡ the discussion of WARING advances the theory of congeneric surd equations only so far as it enables us to arrive at a rational product, of which one of the factors is a given surd expression. And HORNER treats the subject as if it remained in the same state as that in which it was left by WARING—that is to say, as if the elimination of radicals was the only difficulty overcome. In this, as Professor J. R. YOUNG has pointed out,* HORNER was mistaken. Assuming that the orientals *suspected* that there were surd equations incapable of solution, GARNIER directly asserted the fact. "Thus," says he in speaking of the equation,

$$-\sqrt{x-1}=1-\sqrt{x-4}\ldots\ldots(2).$$

"the equation (2) cannot be satisfied when the radicals are taken with the sign plus."† And he accounts for the occurrence of impossible equations in the following manner: "It remains for us to direct attention to the fact that the operations by means of which the radicals are made to disappear, introduce roots foreign to the proposed" equation.‡ So that GARNIER must be understood as having distinctly asserted the existence of surd equations without roots, and also that the appearance of roots which such equations present are the roots introduced by the processes through which we seek to rationalize the equations.

(3). It was by Professor T. S. DAVIES that the attention of HORNER was directed to surd equations. The result was the interesting letter to Professor DAVIES, which the reader will find at pp. 43—50 of vol. viii., of s. iii., of the *Philosophical Magazine*. In that letter HORNER suggested an appropriate name for the whole class of surd equations—the term *congeneric* (p. 49); he gave an excellent notation for the purposes of representing individual equations of that class (pp. 49—50); and he pointed out very clearly the manner in which foreign roots are introduced by the elimination of the radicals (pp. 48—49). These compose his additions to the theory of surd equations, but the whole letter is instructive, as inculcating the true principles on which the processes of the theory of equations are founded.

(4). Some remarks by Professor J. R. YOUNG§ on the equation

$$2x+\sqrt{x^2-7}=5. \quad . \quad . \quad . \quad [A].$$

called forth others upon the same subject by Mr. W. S. B. WOOLHOUSE.‖ It is however to be observed that the subject

* COLEBROOKE, pp. 217—8. It is to be observed that the difficulty which arises from *unreal* roots would present itself, to the early investigators, under an aspect different to that which arises from an equation having no root. No disappearance of surds by suitable assumptions would render unreal roots real, or rather, obviate the difficulty alluded to. But suitable assumptions would always prevent an impossible equation from occurring.

† This problem is referred to by HORNER in the *Phil. Mag.*, s. iii., vol. viii., p. 43, and will be found at pp. 152—157 of the *Med. Alg.* The second method of WARING (pp. 156—7) it is not necessary for our purpose to notice—it involves infinite series.

‡ *Phil. Mag.*, s. iii., vol. viii., p. 43.

* Theory of Equations (London, 1843), p. 40.

† Translated from GARNIER's *Analyse Algébrique* (Paris, 1814), p. 335, art. 92.

‡ Translated from the same place.

§ *Phil. Mag.*, s. iii., vol. viii., p. 519.

‖ *Ibid*, vol. ix., p. 21. The equation in question has attained some degree of celebrity. It was adduced by Professor DAVIES as an example of an

of Congeneric Surd Equations was only in question collaterally, and formed no direct ingredient of the point in dispute between those two distinguished mathematicians. All that it was *material* for Professor YOUNG to assert was, that there was *no sufficient evidence* of the above equation having any root—and yet that roots were indicated by the product of the surd congeners which did not satisfy the above. The remarks of Mr. WOOLHOUSE have been transcribed into the *Gentleman's Diary* for 1837 (pp. 34—35), where they form a considerable portion of the answer of "β" respecting the above equation, the solution of which had been proposed as a question by "PEN-AND-INK." The correctness of Mr. WOOLHOUSE's conclusion is of course undoubted;—it is founded on the implicit assumption that the analytical discussion of the given equation is involved in that of the more general one,

$$2x+(x^2-7)^{\frac{1}{2}}=5\,\ldots\ldots\ldots[B];^{*}$$

this assumption is also correct, but I am in doubt whether it is not such a proposition as ought to be proved *à priori*, rather than assumed. I consider that Mr. WOOLHOUSE's argument establishes the fact of our having *no evidence* of the existence of any solution of the equation [A], in the absence of proof of [A] having analytical properties different from [B]. This *want of evidence* would, perhaps, be all that my accomplished friend would contend for, and it appears to be the point insisted on by "β." The doubt which I have expressed above is founded on some remarks of the geometer who writes under the name of "PEN-AND-INK." He calls attention (Ib. p. 34) to the change of conditions introduced by the elimination of a symbol of operation. Is it self-evident that the elimination of $\surd$ will not *obliterate* as well as introduce conditions? Is it, bearing in mind the observations of the eminent geometer† just alluded to, self-evident that *no quantity other than a root of* (3) *can satisfy* (1)? [See *G. Diary* for 1837, p. 34.] This latter proposition is implied, and, consequently, *assumed*, by GARNIER and HORNER; but it admits of proof, and it is, therefore, improper to assume it. That the operations of elimination materially affect results, it is needless to prove; but the following may not be useless as an illustration:—Multiply a given equation, $xy=0$, into a given factor,

$$\frac{z}{x};$$

then we have $yz=0$, from which a solution ($x=0$) of the given equation is excluded.

(5.) For the above reason, I cannot regard, as altogether groundless, doubts that have been expressed as to the existence of impossible equations. Perhaps some such reason may have weighed with Mr. LUND,* and have operated to neutralize the effect of the consideration suggested by Professor DAVIES in a note (*d*) to my *Analysis of the Theory of Equations*.† However this may be, Professor YOUNG‡ has considered it desirable to exhibit the impossibility with greater clearness than had been before done, and as the result of incompatible conditions. The equation, on which he has argued, is that now under discussion. I have taken certain objections§ to the argument in question, of which my excellent friend has been pleased to admit the validity.‖ Although I consider the proposed method of arguing only applicable to a limited class of surd equations, I feel it due to Professor YOUNG to make especial mention of this part of his valuable "Elementary Treatise on Algebra,"¶ as showing his inclination to regard the subject as not exhausted by GARNIER and HORNER, and as forming a distinct period in the history of the subject.

(6.) The object of my own researches was to clear up the doubt expressed by Mr. LUND. Those researches are familiar to the readers of this Journal. They reduce the impossibility from a symbolical to an arithmetical one. (See *Mech. Mag.*, vol. xlvii., p. 307, &c.)

2, Churchyard-court, Temple, Nov. 30, 1848.

Addendum to IX. *of these Horæ*.**

The following expression for u may be found useful:—

impossible equation (*Ib*. vol. viii., p. 43), and by Professor YOUNG for the same purpose (Theory of Equations, p. 26), besides undergoing the discussions alluded to in the text, and the further ones which will be found in the *Mech. Mag.*, vol. xlviii., p. 182, and *supra* p. 520.

* *Vide supra*, p. 366.

† Professor DAVIES, of Woolwich.

* *Vide supra*, p. 365, &c.

† *Phil. Mag.*, s. iii., vol. xxxii.. p. 358.

‡ *Algebra*, 4th edition, pp. 131—2.

§ *Mech. Mag.*, vol. xlvii., p. 331.

‖ *Mech. Mag.*, vol. xlvii., p. 546.

¶ London: Souter and Law. 1844.

** *Vide 'uprr*, pp. 518—521.

$$u = \frac{p\left\{(p'x+\tfrac{1}{2}q')^2+p'r'-(\tfrac{1}{2}q')^2\right\}}{p'\left\{(px+\tfrac{1}{2}q)^2+pr-(\tfrac{1}{2}q)^2\right\}}$$

I may add, that u is always equal to $(\pm 1)^2$ when x_1 and x_2 are substituted for x in the above formula.

SLOPING AND VERTICAL SEA WALLS.

Sir,—It appears, from the last Number of the *Mechanics' Magazine*, that your correspondents are yet able to give the "Sea-wall Question" an interesting turn, and elicit new views of this truly important subject of inquiry.

I am a constant reader of your Magazine, and have carefully considered what has been urged upon both sides of this question. In the earlier part of the discussion, a point was suggested relative to that portion of Sir J. Rennie's account of the Plymouth Breakwater, where he asserts that the waves of the sea established an angle of repose upon a slope of 5 to 1, which they failed to do upon the higher incline of 3 to 1. The only explanation which has been attempted of this seemingly paradoxical result, was given by Mr. Dredge, with his usual ingenuity and ability; but, if I mistake not, he rests his explanation of the phenomenon upon an assumed degree of elasticity in the material of stone, which, I believe, experiments and observed facts would not bear out.

As the discussion has been again resumed in your valuable pages, I would beg to direct the attention of your able correspondents to what appears to me a most important *practical* point, namely, *Can an "angle of repose" be established between the force of the sea and the material of a long pavement; and if so, what are the conditions of equilibrium?* I am, Sir, yours, &c.,

A Constant Reader.

HOW TO RAISE SPIRITS FROM THE DEEP.

We quote from the *Norfolk News* the following remarkable testimony to the value of the Fountain pumps of our old correspondent, Mr. Shalders:—"With a view of testing the pretensions of rival professors in this line, Messrs. Norgate and Co. have had fixed at their spirit stores, St. Stephen's (Corner of Surrey-street,) half a dozen highly-finished brass counter engines, each delivering half a pint per draw, through 15 feet lengths of suction pipes, and the common half-inch taps inserted into their respective brandy, rum, and gin casks in a cellar beneath. On trial being made, it was found, from the far superior principle of diaphragmic action, and more scientific construction, that a Norwich engine, the invention and manufacture of our fellow citizen, Mr. Wm. Shalders, jun., would fill a gallon (imperial) in less than ten seconds, whilst the engines from the first London makers, Messrs. John Warner and Sons, and Messrs. Pontifex and Wood, could not raise the same quantity in double the time, although requiring, at moderate speed, more than double the force to work. Neither do they compete with the Norwich Engines in durability, facility of examination, and repair—for steady, silent action, or any main qualification. The number of similarly constructed engines extant may be counted by millions, giving a wide field of amusement for their different owners to ascertain whether they can make a nearer approach, through the same contracted passage ways, to Shalders' celebrated fountain, beer, cyder, spirit, &c. &c. Engines, which, with longer pipes and deeper lifts, would leave the old piston and cylinder scrape-and-go principle, still further in the lurch."

THE ZINC WORKS OF STOLLBERG.

The small town of Stollberg, about four miles from Eschweiler, is a centre of great manufacturing activity. Perhaps the most interesting establishments for strangers are those for producing zinc from calamine. The best mines belong to the company of the Marquis de Sessenaye, a French gentleman, who established here zinc works on a large scale, in which the following system is adopted:—

A chimney of considerable width, but of moderate height, stands in the centre of each batch of furnaces. In the middle immediately adjoining the chimney are two roasting furnaces, in which the ore is calcined. To the right and left of these are two pairs of reducing furnaces, or rather two large reverberatory furnaces, which are charged in the middle from above, and which are open at the side towards the gangways. In the space between the middle, or firing-place, and these openings, are placed a series of retorts of fire-proof clay, of elliptical shape, into which moveable necks are inserted, that communicate with short perpendicular pipes, which fit into holes in the hearth-plate, under which openings like an ashpit are constructed. The ore having been well calcined in the roasting furnace, and turned from a carbonate into an oxide of zinc, is first powdered. The oxide is then placed in the retorts, or muffles, as they are called, and the furnaces are carefully closed with clay, and highly heated to throw off the oxygen in the shape of gas. One result of the great heat in this process is, that a large proportion of the metal escapes with the oxygen, which finds its way through the neck of the retort and down the tube connected with it, where the reduced metal falls in small globular particles. The metal thus deposited is washed from the refuse that falls with it, and is melted in furnaces placed at the extremity of the reverberatory furnaces. The heat of these serves to melt the zinc, that it may be cast into thin blocks for rolling into sheets. The production of these works is estimated at 10 tons per diem. For this a consumption of seven times the weight of coal is assumed, and the manufacture of the metal could, consequently, only be undertaken where the coals are on the premises, as may here be said to be the case.—*Banfield's History of the Rhine.*

GOSSAGE'S IMPROVED ENGINE PUMP.

Sir,—Every nautical man knows that a *good* engine pump is a most useful piece of mechanism on board a ship, for a great variety of purposes; but, to be really useful, it must combine several peculiarities. It must be portable, powerful, capable of standing the "rough and ready" handling of the "jolly tars," as frictionless and as durable as possible in all its working parts. The engine pumps most extensively used in the British navy have been Captain Fisher's, described by me twenty years ago, at page 178 of your 9th volume, and Hearle's patent pump, described at page 178 of your 30th volume. In the engine of Captain Fisher there were two working barrels, with solid pistons (or force pumps), with an air vessel placed between them; all the working parts being fixed to and supported by an iron frame, independent of the outer casing. Hearle's engine consisted of two lifting pumps, placed within a metal casing, which casing formed the air vessel of the engine. In both these engines leathern valves were employed. Hearle's pumps have been very extensively used, but the numerous and continual complaints made to the Admiralty by the officers on the various stations, led Mr. Gossage to consider the best method of removing the grounds of complaint. In classifying the defects, as pointed out, a remedy soon suggested itself. In both Fisher and Hearle's engines, the valves being of leather, required to be kept constantly wet to ensure their action when required; in the latter, there was much complexity in the attachment of the hose and other furniture of the engine, as well as great difficulty in keeping the air vessel intact, especially after needful repairs had occasioned the taking to pieces of the engine.

The prefixed engraving shows Mr. Gossage's improved engine pump, as manufactured for the Admiralty by Mr. Stone. It embodies all the best features of previous contrivances with peculiar merits of its own; it consists, like Captain Fisher's, of two forcing pumps, with an air vessel placed between them; but, instead of the valves being of leather, they are of metal. An oval metal casing, similar to Hearle's, is retained; but, instead of forming an air vessel, it is only a support (and at the same time a protection for) all the working parts. There are but two openings, an inlet and an outlet orifice, for the suction and delivery hose; a double connecting screw, affording the means of affixing two lines of delivery hose when required. In Hearle's engine, the range of the handles is exceedingly

inconvenient, and prevents the men working with the proper speed or comfort. Upon the occasion of a recent trial, I observed, that with Gossage's engine, a greater number of strokes were made, and a larger quantity of water delivered by the men in a given time, and with considerably less fatigue to the men, than could be accomplished with Mr. Hearle's. The selection of the *gear* that accompanies Gossage's engine pump is exceedingly judicious; its systematic arrangement, aided by the printed (and illustrated) description, and directions for its use, will be found invaluable to the service.

Gossage's engine pump is available for all the purposes of a lift or force pump; it may be used as a fire-extinguishing engine—as a watering engine for filling ships' casks—a wash-deck pump, &c. It is not injured by being kept dry, (as are all eathern-valved pumps,) and is therefore suited for all climates. Having but one inlet and outlet screw (of different sizes) all possibility of error in affixing the respective hoses is removed. The valves being of metal are not likely to require repair or to be removed from their places, for many years; the longer they are used the more perfect will they become.

The principal advantages of Gossage's engine over those hitherto used in the navy, may be summed up as follows: 1. Greater portability and working in less space. 2, Greater durability under the action of sea water, by the substitution of gun metal and copper, in lieu of iron. 3. Metallic valves in lieu of leather. 4. Simplicity of construction, which affords great facility for repairing and oiling the several parts, especially those most liable to friction. 5. Its diminished cost. 6. Being chiefly composed of mixed metal (which will be valuable when the pump is worn out) in lieu of cast iron.

I remain, Sir, yours respectfully,

WM. BADDELEY.

29, Alfred-street, Islington, Nov. 28, 1848.

MR. DREDGE AND THE WESTON-SUPER-MARE PIER AND BRIDGE COMPANY.

(From *Keene's Bath Journal**.)

Many of our readers no doubt participate with us in feelings of regret at what may be considered the termination of the Weston-super-Mare Pier projection. Regret not only for the Company and the failure of the undertaking, but for Mr. Dredge, a man of high integrity, superior talents, and remarkable energy of purpose.

About two years ago we had reason to anticipate the connection, by a bridge, of Birnbeck with the main land, which, had it been accomplished, would have been one of the most surprising, interesting, and valuable achievements of bridge architecture in the kingdom; of immense benefit to Weston-super-Mare, not only commercially, but in point of attraction, in giving additional walks and splendid sea views for visitors; of commercial advantage to South Wales and to the South of England, and profitable to its proprietors. The finale of all is, however, unfortunately, an immense expenditure of money, in law, to obtain the bill, in iron works prepared for the structure, and in the erection of masonry which is now demolished by the ruthless waves, and the engineer crushed by his heavy outlay and legal costs, seeking a wind-up of his affairs in the Court of Bankruptcy. This is bad enough, but bad indeed is the case with Mr. Dredge, when we find this is not the worst of his grievances, when we find the Pier Company pursuing him with vehement opposition, and doing, whether intentionally or not, all that can be done to crush his reputation. There are two circumstances, however, in his favour, that will doubtless maintain for him his position with the public. First, his fame as a bridge constructor was established before the Weston-super-Mare projection was contemplated, and the masonry or pier, and his invention—the suspension bridge—are two distinct things. The destruction of the stone work, which we suppose in his zeal he undertook, seeing that no contractor would take it for any sum within the limits of the Company's funds, after paying for the iron work, but which, in our opinion, he ought to have had nothing to do with, does not affect the credit of his invention for the suspension bridge at all; it has indeed nothing to do with it. In this respect therefore, Mr. Dredge's credit as a bridge architect is perfectly uninjured. And, secondly, as a man of integrity, who can doubt this, when the debts proved against him,

* We entirely concur in the view of this case taken by our provincial contemporary, and gladly volunteer the aid of our columns, to spread far and wide, his very just notions on the subject of engineering contracts, and his eloquent vindication of the meritorious individual whose professional character is here involved. The Mr. Dredge spoken of is not, it may be proper to observe, the gentleman of the same name whom we have the pleasure of ranking among our most valuable contributors, but a near relation.—ED. M. M.

excepting that of the Pier Company, is only £200, as we learn, and not £300, as stated in our report last week? Mr. Dredge, then, owes the Company, according to their own statement, £1,720, having himself expended between three and four thousand pounds for iron work, &c.; which, they say, is their own, and in their possession, while all his other debts are only about £200. This will hardly argue away his credit as a man of integrity.

And now what is the case between Mr. Dredge and the Company? Mr. Dredge maintains that he could have fulfilled his contract provided he had been fairly dealt with. In order to complete the masonry in the most hazardous place that could anywhere perhaps be selected, where the dash of opposing waters is at all times tremendous, and often most awfully so, it was necessary to commence the work at the very earliest available season; but without any fault of the engineer, and totally contrary to his wish, it was delayed more than a month, and after having commenced in full earnest, he found other difficulties to arise, the chief of which was the non-fulfilment of the contract on the part of the Company. Having worked on hopelessly until £840 of that which was guaranteed by contract to be paid him monthly was overdue, he then gave notice that he would stop the works unless payment were made, in default of which the works actually were stopped, and the money panic was soon after followed by a panic of the wind and waves, and the rolling tide swept over the unfinished work, and shelved off layer after layer of heavy masonry successively, until nearly the whole became a heap of ruins. Whether or not the masonry would have been strong enough to sustain such violent concussions, when the wind was uprooting trees and unroofing houses, and the whole town in consternation, is more than we can venture to assert. The most experienced architect and builder might have found himself at fault with the elements so forcibly against him, and we believe by none would the work be considered less than a most daring enterprise. Surely, under circumstances such as these, there ought to have been some little sympathy for the engineer, some kind consideration; but no! not the least—on the contrary, if not bitter persecution, hostility of harsh and unrelenting perseverance.

According to representations publicly given by Mr. Dredge, instead of his being indebted to the Company 1,720*l.*, the Company was indebted to him 1,760*l.*, and we must agree with Mr. Dredge that the verdict for the former sum was consequent on an erroneous construction of a clause in the contract. The clause alluded to provided "that the money paid from time to time shall never exceed the value of the work done and the materials permanently deposited on the Company's land." According to this clause, we should understand that the contract was complied with when the materials were deposited on the Company's land so as to be permanently their property; the Judge, however, gave a different construction. How? Why by giving a different word. The Judge ruled that permanently *deposited* meant permanently *fixed*. What reason the learned judge could have for putting the word fixed for deposited, we cannot understand. The word *fixed* is certainly not in the bond, and if it were what could be made of it? The materials were deposited on the land *not* to be fixed there, but to be suspended over the waters. What could the learned Judge mean? The materials are on the land, and therefore deposited there; but they were never intended to be there permanently fixed. If his lordship considered the sea as the Company's land, he must then have construed the contract to mean that Mr. Dredge was not to be paid anything till the whole work was finished, for fixing the bridge—the entire bridge—on the piers, is the very finishing of the work. The verdict is, in our opinion, obviously an error. The verdict, however, such as it is, the Company have, and we only wish we could see them disposed to use it more mercifully. In our opinion, a very different course of conduct would have been better for the Company, for Mr. Dredge, for Weston-super-Mare, and for the public. The damage, according to Mr. Dredge's shewing, was not more than 350*l.* What was this in such an undertaking—and this, too, his own loss—had the work been continued? Then why did not the Company find funds for its progress, as he was willing to go on, and confident of success? Indeed, had it cost a few thousands more than the original contract, what would the Company then have had? Why a noble bridge extraordinarily cheap, less than one half—perhaps one quarter would be nearer the mark—than the sum for which any other engineer would construct it. What, indeed, would be twice the amount, or a loss of 3,000*l.*, instead of 300*l.*, for such a work, in comparison with the expenditure for the Clifton Suspension Bridge, about which above 40,000*l.* have been expended, and only a rod appears, after nearly twenty years, to swing people over in a basket?

We speak of Mr. Dredge as a man whose talents are public property, valuable in proportion as the public know how to foster them and use them, and not destroy him by

persecution. We fully believe that, under better treatment, he would have recommenced his gigantic work at Weston-super-Mare, that the accident would have led to improvements, and that, by this time, the bridge would have been completed; and we believe, also, that the whole country would be wonderfully improved by having such structures in many places where rivers cut off the communications of populous neighbourhoods, and to supplant many clumsy and ricketty fabrics.

The Weston-super-Mare Pier Company have done Mr. Dredge one gross injustice, They maintained that the materials were not permanently deposited, and thus obtained their verdict at the trial; while, to obtain their advantage in the Court of Bankruptcy, they maintained the contrary, and the verdict condemned them. Why, if the materials were not permanently deposited, why withhold from Mr. Dredge property so valuable to him, and which he could, ere this, have profitably used for the benefit of his creditors, while to them it is comparatively worthless in consequence of what has taken place?

This is not the way to proceed to any good purpose, and tends only to the fulfilment of Mr. Dredge's prediction. He told the Company, at their half-yearly meeting in February, that, "if they allowed disputes to arise, it would be of serious consequence to himself and to them, and fatal to the undertaking." This it is now proving to be; the ultimate issue of the quarrel will be an expenditure of some 7,000*l*, or 8,000*l*., and no bridge.

The facts of the case appear to be plainly and briefly these:—Mr. Dredge had expended between 3,000*l*. and 4,000*l*., and the Company had advanced him only 1,100*l*.; and had Mr. Dredge continued the work, it would have been no injury to the Company, but a delay of a year as to time, and a loss of only 350*l*. in the destroyed work, which would have been suffered entirely by Mr. Dredge.

We regret the fate of the pier undertaking the more, as Mr. Dredge has devoted the best years of his life and his capital to a most useful public purpose, that of developing a principle in the construction of bridges, which is of immense importance. Such, however, is the misfortune of most men like him who venture on a departure from the trodden path, and though we are entirely indebted to them for every improvement in science, it is seldom they reap any reward but empty posthumous honours.

LATHROP'S PATENT CORRUGATED RAILWAY WHEELS.

[Patent daed June 6, 1848. Patentee, Benjamin Lathrop, King-street, Cheapside. Specification enrolled December 4, 1848.]

Abstract of Specification.

Hitherto it has been the practice, in making wheels of cast-iron, to have a division or divisions across the nave, to allow of the whole mass contracting with as little strain as possible—malleable iron hoops being then shrunk on to the nave to keep it together.

The nature of this invention is, the casting of an iron wheel in a chill in one piece, of such shape as shall cause the iron to remain without strain when cold.

The mode of carrying this into effect, is as follows:—Taking, as an example, a wheel 3 feet in diameter, shown in the engravings. Fig. 1 represents a side elevation of the wheel, and fig. 2 a section on the line A, B, fig. 1—the metal of the nave being about 1¼ inch in thickness, 8 inches in length, and 8 inches in diameter, with a hole in the centre for the axle; there being a hollow space left in the interior of the nave, as shown by fig. 2. The tyre or rim of the wheel is of the usual form, and may be made with or without a flange, as required—the thickness of the tyre or rim being about 1½ to 2 inches. The nave, and tyre or rim, are connected together by the part equivalent to the spokes of a common wheel, and which may be called the disc. The disc is about half an inch thick, and is so formed as to be corrugated in concentric circles in the plane of the wheel's motion, and, at the same time, in the line of the radii in a plane at right angles to that plane. Fig. 3 shows the form of the edge of the disc at its junction with the tyre or rim, and fig. 4 at its junction with the nave. In the engraving, fig. 1, the disc is represented as consisting of ten great corrugations on the plane of the wheel's motion. Fig. 2, shows the form of section along the top of one of them; the number of corrugations; or the dimensions here given may, of course, be varied according to circumstances.

Mr. Lathrop describes a second form of disc, which is the doubly corrugated one above described, with the addition

Fig. 1.

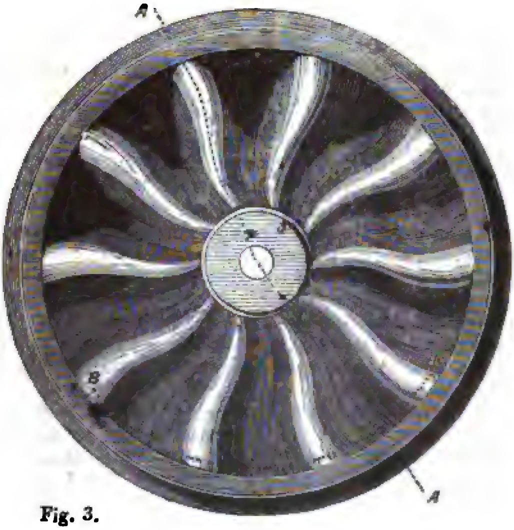

Fig. 2.

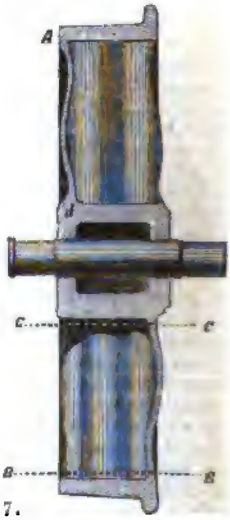

Fig. 3.

Fig. 7.

Fig. 5.

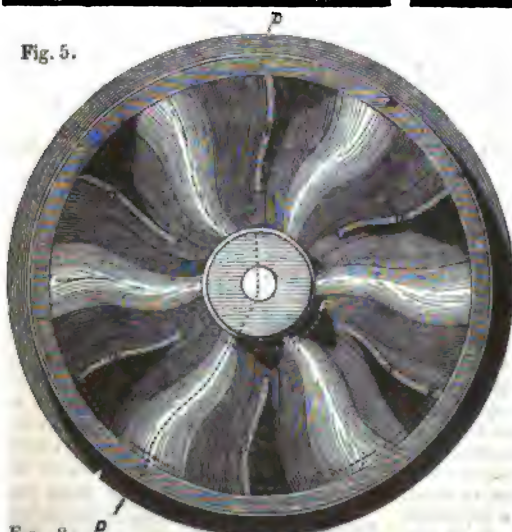

Fig. 6.

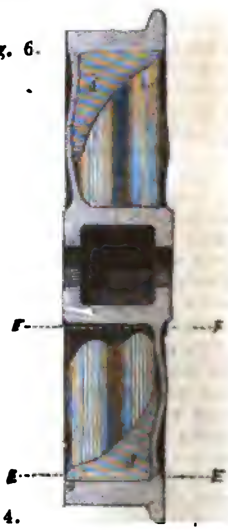

Fig. 8.

Fig. 4.

Fig. 9.

Fig. 10.

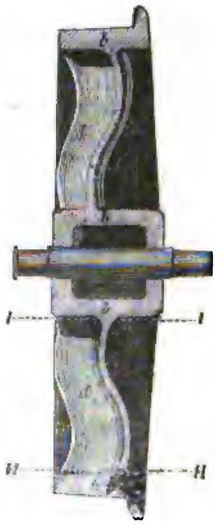

Fig. 11.

Fig. 19.

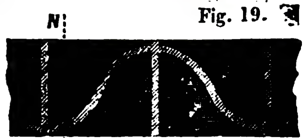

Fig. 14.

Fig. 15.

Fig. 20.

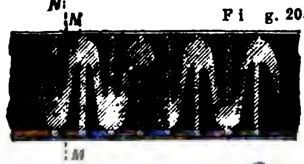

Fig. 17.

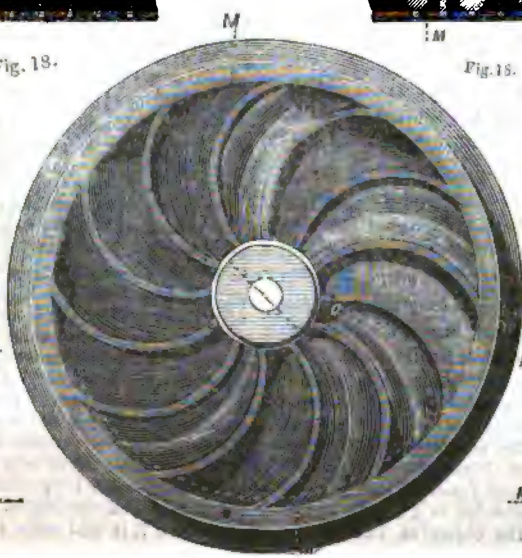

Fig. 18.

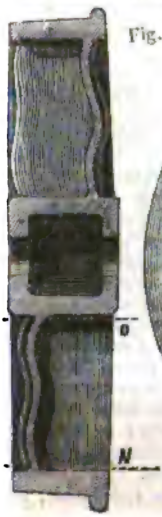

Fig. 16.

of a set of curved or otherwise bent projections extending from the tyre or rim, more or less, towards the nave, and intersecting the disc at right angles to the plane of the wheel's motion. Fig. 5, shows the form of the edge of this disc to the projections at the junction with the tyre, while another form of the projection is shown by fig. 7.

A third form of disc is shown by fig. 8, corrugated on the radii in the plane of the wheel's motion, as shown by the section fig. 9, at *b b*, with the addition of the curved projections extending from the nave to the tyre or rim, and intersecting the disc at right angles to the plane of the wheel's motion. Fig. 11 shows the form of the edge of the disc at its junction with the tyre or rim, and fig. 12 at its junction with the nave.

Another form of disc is shown in plan, fig. 17. Of which figs. 18, 18, 19, and 20, are sections on the lines MM, NN, OO. Figs. 14 and 15 are sections on the lines KK, LL, of fig. 18.

The above wheel or wheels may be made with a malleable iron tyre.

MR. WEALE'S RUDIMENTARY TREATISES ON THE ARTS AND SCIENCES.

1. *On the Steam Engine. By Dr. Lardner.*
2. *Natural Philosophy. By Charles Tomlinson.*
3. *Architecture. By W. H. Leeds.*

The handsome style in which this Series of Treatises is being produced and their exceeding cheapness (only 10*d*. each) are of themselves sufficient to command for them an extensive sale; but we are happy to be enabled to say, that if the average style of execution does not fall below that of the specimens before us, they cannot be more extensively circulated than they deserve.

We thought at first, on reading the Preface to the *Steam Engine* Treatise "By Dr. Lardner," that the Doctor must have lent his name merely to the work, and could have had no hand in its composition. *His* certainly was not *the hand* to indite such a specimen of shop-bill English as this:

"In this little book an attempt has been made to supply, in *generally* intelligible language, an explanation of the facts and mechanical principles on which the structure and operation of Steam Engines depend. Within the proposed limits of bulk and cost *it would be* impossible to give much practical detail. The object *is*, therefore, to supply those who desire *to learn how it is*, that the Steam Engine has accomplished the miracles of power for which it has been so celebrated with the means of doing so, without the technicalities of art *and science*, and in a form and manner which will not require a greater amount of time and labour than they can readily bestow upon it. It is hoped that the simplicity of style and language and the comprehensive plan which have been adopted will attain this end, and that almost all who have *learned to read*, may in these pages *learn how it is*, that steam power plays the important part ascribed to it in the arts and manufactures."—*Pref.*

On turning to the Treatise itself, however, we soon became satisfied that it was a veritable production of the accomplished Doctor's pen. It bears here and there marks of haste or carelessness—where he states, for example, p. 5, that pistons are packed with hemp alone, and afterwards, p. 33, that they "are rendered steam-tight either by vegetable or metallic packing;" but it is on the whole worthy of Dr. Lardner's high scientific reputation. We select a specimen or two.

How the Mechanical Action of Steam may be augmented by Heat imparted to it directly.

1. In all the ordinary applications of steam, the heat imparted is applied to water from which the steam used for mechanical purposes is raised. Heat, however, may be imparted directly to the steam itself after it has been separated from the water, and, when so applied, it will augment in a certain proportion to the mechanical efficacy of the steam.

It has been thought by some projectors that heat applied in this way might be rendered more efficacious than when applied in the evaporation of steam from water. It may therefore be worth while to explain here to what extent the mechanical power of steam can be augmented in this way.

"It is a remarkable fact, that the effect of heat applied to air and all species of gases in augmenting their volume is precisely the same. It is found that if air or any species of gas be confined within a certain volume, and that heat be applied to it until its temperature be raised one degree, its elastic force will be augmented by one 480th part of its whole amount. Thus if a certain surface of the vessel which contains it suffer a pressure from its elastic force of 480 lbs. the same surface will suffer a pressure of 481 lbs. from the temperature of the air or gas being raised one degree.

2. Now it is still more remarkable, that

the very same law applies to every species of vapour, that of water included. If then a cylinder containing steam excluded from contact with water be exposed to any source of heat, it will receive the above augmentation of pressure for every degree by which its temperature is elevated. This increase amounts, in round numbers, to one-fifth per cent. of the whole mechanical effect.

4. It is scarcely necessary to say, without going into details for which our limits would not afford us space, that the same quantity of fuel which would produce this increase of mechanical effect, applied directly to a vessel containing steam, would produce a greater mechanical effect, applied to a boiler to produce steam from water.

It is therefore not necessary to dwell further on this principle, as invention has not yet profitably employed it in the case of steam.

High and Low Pressure Engines.

1. It will be perceived that the advantages obtained by the vacuum produced by the condensation of steam are not without drawbacks. The machinery for condensation is costly, bulky, and heavy, and, moreover, consumes a considerable portion of the moving power in working it. The condenser requires a cistern of cold water, in which it is submerged. This cistern must be kept constantly supplied with cold water, for which purpose a pump, called the *cold water pump*, must be worked by the engine. The water and air admitted by the condensing jet must be continually pumped out by the air pump. In many cases the steam engine is worked in situations in which a sufficient supply of cold water cannot be procured, and where the weight and bulk of the condenser, air pump, and cold water pump, would be inadmissible. In these cases the power of the steam must be worked without the advantage of the vacuum on the other side of the piston. Engines thus constructed are called *non-condensing engines*, and sometimes, though not with strict propriety, *high-pressure engines*. Steam having a greater pressure than that of the atmosphere being admitted on one side of the piston, and the other side being left in open communication with the atmosphere, the piston will be urged forwards by a force proportional to the excess of the steam pressure above the pressure of the atmosphere, the friction, and other resistances. When the piston is thus drawn to the other end of the cylinder, the steam being admitted on the opposite side of the piston, and the contrary side being open to the atmosphere, the piston will in like manner be urged back again.

2. Between the *mechanism* by which the admission and emission of the steam is effected in this machinery, and that which we have described in the condensing engine, there is no real difference. Whether the steam be allowed to escape to the condenser or into the open atmosphere, the mechanism which governs its admission and escape will be the same.

3. As the pressure of the steam in such machines must necessarily exceed that of the atmosphere, in a sufficient proportion to supply a force necessary for the purpose to which the machine is applied, the pressure is always much greater than is necessary where condensation is used; and hence the application of the term *high-pressure engines* to such machines; but the use of the term is objectionable, inasmuch as steam of an equally high pressure is often used in engines in which the steam is condensed and a vacuum produced. An example of this is presented in the engines used in Cornwall, where steam having a pressure of 50 lbs. or upwards on the square inch is used.

4. Properly speaking, therefore, *high-pressure engines* consist of two classes; those in which the steam is not condensed, and those in which it is condensed.

5. The most proper classification of engines, therefore, is into *condensing* and *non-condensing engines*; the latter being always high-pressure engines, and the former sometimes high-pressure and sometimes low-pressure.

6. By low-pressure engines is to be understood those in which the safety-valve on the boiler is loaded at the rate of 4 to 6 lbs. per square inch.

7. High-pressure engines is a term rather indefinite; but where the valve is loaded with 20 lbs. or upwards per square inch, the machine is generally so called.

8. In the United States, the use of high-pressure steam is much more universal than in England, and 20 lbs. upon a square inch of the safety-valve would hardly be denominated high pressure. This will be understood when it is stated that from 120 to 150 lbs. per square inch is not a very uncommon pressure to use.

9. In locomotive engines, the condensing apparatus is excluded for obvious reasons. The pressure in these is usually from 50 to 60 lbs. per square inch. The steam which escapes from the cylinder, after working the engine, is ejected up the chimney, where it plays the part of a blower, and supplies that want of elevation of the chimney which circumstances here exclude.

Mr. Tomlinson's "*Natural Philosophy*" is a very masterly performance; exact,

lucid, and (beyond most works of the same class) interesting. It has its "Preface," too, but one which is, happily, of the same grain with the work, and contains a piece of advice to "the reader" of so just and sensible a character, and of such general application to the readers of all scientific works, that we beg to indorse it with our heartiest concurrence:—

But if scientific men are disposed to prepare popular treatises, and intelligent publishers to issue them, at a price sufficient to bring them within the reach of every one, it is not too much to expect the co-operation of the reader in carrying out so praiseworthy an object. The reader must be prepared to bestow a higher effort of mind in the perusal of the work than is required for the appreciation of a romance, or even of a treatise on *popular science*, as this term is often understood. He must be prepared to *study* the work, and not merely to glance over its pages. If he find it difficult on a first perusal, let him give it a second, or a third, and we may venture to assure him that his labour will not be misapplied."

We quote, as a specimen of this treatise the following historical notice of

The Transits of Venus.

Every circumstance confirms, and exact observations show, that her distance from the sun is never less than ·71837, nor more than ·72829 of the Earth's *mean* distance from him. Venus's orbit is more nearly circular than that of the Earth, though this latter is less eccentric than that of any other planet. But it is plain that the Earth's motion round her orbit, in the same direction as Venus, but more slowly, must make a material difference in these appearances. If, however, we regard both orbits as circular (which is very nearly the case), it will be seen that the only effect will be to make Venus appear to occupy a longer time in running through these changes than she really takes to make one revolution. The true period is only 224 days, while the apparent, as we have seen, occupies about twenty months, or 584 days, viz., the time during which the two planets, after starting from a conjunction, will come to a conjunction again (as the two hands of a clock come together after 1 hour 5 minutes and $\frac{5}{11}$), for during 584 days the Earth has made about one revolution and $\frac{8}{13}$, while Venus has made $2\frac{8}{13}$.

But when we speak of Venus as passing *before* the sun, it must be remembered that she does not generally pass exactly before his *body*, but a little above or below, in consequence of the inclination of the plane of her orbit to that of the Earth. The various planets and satellites do not move in the same plane; if they did, every conjunction of three bodies would cause a *transit*, *occultation*, or *eclipse*. But this cannot take place with the Sun and Venus, unless she be in her conjunction, and at the same time near one of her *nodes*, or points where she crosses the plane of the Earth's orbit. We are opposite these points on every 6th of June and 7th of December; therefore, when Venus is in inferior conjunction on or very near one of these days, she will be seen to pass before the sun's body like a black spot. But this is so rare an event, that it has only happened twice since the revival of science.

The first time this was observed was on the 4th Dec., 1639, or 24th Nov., O. S., not by an Astronomer Royal, surrounded with every means of exact observation, but by a young man of twenty, furnished with no other instrument than a piece of smoked glass. This individual, named Jeremiah Horrocks, had, by deduction from the true system of astronomy (then hardly established), been led to expect this effect, overlooked by Copernicus and his successors. On the day which he had calculated, he began to watch the sun from his rising till the hour of attending Divine worship, for it was Sunday; and we are told that he did not allow this duty to be interfered with by his observations. Between the morning and evening service he again watched the sun, without success. At length, towards sunset, the expected spot made its appearance, and the truth of the new theory received one more in addition to its many other confirmations.

He showed that the next transit would take place in 1761; and as this year approached, far different preparations were made from the smoked glass of Horrocks, 120 years before. It was to observe this transit that Captain Cook was sent on his first voyage to Otaheite, and that other astronomers dispersed themselves over various parts of the world; for Dr. Hooke had shown the value of such an observation as the *only means* of arriving at the absolute sizes of the orbits of Venus and the Earth, and hence determining the *scale* of the solar system, till then known only as regarded its *proportions*.

Another transit of Venus took place eight years afterwards, which was observed with equal care; the next, however, will not happen till 1874, and again in 1882.

* * * * *

The Treatise on ARCHITECTURE is by

one of the first architectural critics of the day, (perhaps the very first) and has nothing to fear from the worst that rival critics or chastised pretenders can advance against it—which, assuredly, is saying a great deal, but not more than we conscientiously believe to be true. It is confined to the "Orders" and their "Æsthetic Principles"—of which modern term *Æsthetic*, there is a clever definition in a most useful "Glossorial Index," annexed to the work, and which definition we here quote for the benefit of those—not a few—to whom the exact import of the phrase is still somewhat of a mystery.

Æsthetics — *Æsthetic.*—A modern architectural writer condemns these terms as 'silly and pedantic' ones that have 'lately come into use in the arts,' and as 'useless additions to the nomenclature' and language of art-criticism. In what respect 'Æsthetics' is at all more pedantic than 'Optics,' 'Mathematics,' 'Physics,' and other words of a similar class now familiar to English ears,—although they are all of them essentially Greek,—or more pedantic than a great many architectural terms which are not only Greek but altogether technical, it is not easy to divine; while as to silliness, there seems to be far greater silliness in rejecting, or objecting to, than in adopting terms which are not only highly expressive and convenient, but have found their way into every European language, from that of Russia to that of Spain.

The term Æsthetics implies the perception and the study of those qualities which constitute the beautiful and artistic, and form the finer essence of all productions of fine art. It carries with it, therefore, a more exact and philosophic meaning than the word taste. In its adjective form, in which it more frequently occurs, it is particularly useful, as no adequate epithet can be substituted for 'Æsthetic.' Thus we speak of the 'æsthetic sense,' of 'æsthetic feeling,' or 'study,' or 'principles,' &c.; but we cannot say the 'tasteful sense,' or 'tasteful study.' As to the species of study just alluded to, no term may be required to designate it, because study of the kind is generally dispensed with for architecture, an historical and technical knowledge of it being deemed sufficient, without any acquaintance with those comprehensive *æsthetic* principles of the art which can guide us where technical rules stop short, and mere rules abandon us to error or to doubt.

Mr. Leeds' treatise is calculated not only to facilitate, but greatly to elucidate the study of fine art architecture. Stale as is the subject of the Orders, it is here invested with the charm of freshness, and treated with a degree of intelligence which contrasts very strikingly with the heavy pedantry, verbal prosing, and hectoring dogmatism, which—out of compliment, perhaps, to Vitruvius—seems to constitute the literary *etiquette* of nearly all other architectural writing. Besides being far above the average stamp in point of mere authorship, the present Treatise has evidently been the result of much and earnest study directed by intelligent reflection. We obtain a just appreciation of the respective Orders, and the system founded upon them, without any of the cant of prejudice, or the formal enthusiasm—generally very hypocritical also—of the travelled and untravelled (locomotive and vegetative) *dilletanti* of the day. Although Mr. Leeds totally discards the doctrine of the *five* orders, reducing them to *three*, viz., the first, or Doric order; the second, or voluted capital (Ionic) order; and the third, or foliaged capital one (Corinthian)—(agreeing in this with Professor Donaldson)—he greatly extends the privileges of design with regard to them, by showing how widely varieties of one and the same order differ from each other, and claiming equal freedom for the art in all ages and countries. Hitherto, mere dry rules unaccompanied by any reasons for them, have been laid down and blindly followed, the consequence of which has been, that a sort of stereotype pattern has been established for each order, to the exclusion of all artistic study and treatment. This system, no doubt, so far places all architects upon the same level; it elevates the dwarfish in talent, but it lowers those who might show themselves of lofty stature in art; it produces uniformity, but it is by producing uniform mediocrity.

We can honestly recommend this Rudimentary Treatise, as being more likely than anything we know of in print, to dissipate many prejudices and errors, and all that professional mystification which has hitherto been thrown over the subject. Nor is its importance diminished—if anything, it is

increased—by the insignificance of the price of the Treatise, because the opinions which it advocates must now be promulgated a thousandfold. Had they been given to the world in a volume costing as many pounds as this costs pence, they would have been locked up from all except a very few, and among these, perhaps, they would have found still fewer readers.

ENGLISH SPECIFICATIONS ENROLLED DURING THE WEEK. ENDING DEC. 8.

WILLIAM JAMES BARSHAM, Stratford, Essex. *For improvements in mats.* Patent dated June 1, 1848; specification enrolled December 1, 1848.

These improvements consist in manufacturing mats with the fibres on end held tightly between laths, so that they are formed with channels between each row of fibres. For this purpose a cord of cocoa-nut fibre, or other suitable material, is wound round a number of laths, which are then laid side by side in a compressing machine, the cords on the end laths being previously made fast by nailing two other laths over them, or otherwise, as may be desirable. The laths are kept down and prevented from jumping up over one another by their ends resting in grooves in the framework. When pressure is applied from any convenient source through the intervention of a screw and pinion, or other suitable means, the laths are forced into close proximity with one another, so that the cord between them is compressed, and thereby held tightly. The ends of the laths are made fast in a metal frame, so as to keep them as close together as they were in the compressing machine. And the cord is slit up the length of each lath. When the fibres are worn out the laths may be recovered.

Claim.—The mode of manufacturing mats before described.

THOMAS BURDELL TURTON, Sheffield. *For certain improvements in machinery for bending and fitting plates or bars of steel, iron, and other materials, to be used for locomotive engine and carriage springs, and other purposes.* Patent dated June 1, 1848; specification enrolled December 1, 1848.

The invention sought to be secured under this patent has for its object the bending of plates, or bars of iron, or steel, by rollers or blocks into segments to form springs (and in some cases in such manner that they may fit into one another) for locomotive engine and carriage springs.

The rolling machine consists of a strong iron table, through which pass three vertical spindles; one of which is supported in a fixed bearing, and the other two in loose bearings to admit of their positions, with regard to the first, being varied. On the portions of the spindles that project above the table are keyed three rollers. Underneath the table is a horizontal shaft carrying at one end a toothed wheel, that gears into a bevel wheel keyed to the vertical spindle, which is supported in the fixed bearing. On the other side of the bevel wheel gears a toothed wheel, which is carried on a loose collar passed over the shaft. Both shaft and collar are furnished with separate pulleys, to either of which rotary motion is communicated from any prime mover by means of an endless band, according as it is desired to turn the shaft, and, consequently, the roller in one direction or the other. The second roller is supported in a loose bearing, so that its distance from the first may be varied to suit the thickness of the plate or bar to be curved, while the third is so carried as to allow of its being shifted to a certain extent either on one side or the other (in front) of the space between the first and second rollers. The second and third rollers are caused to rotate by the friction of the plate or bar passing over their peripheries. The plate or bar, on issuing from between the first and second, is caught by the circumference of the third, and is thereby bent. The curvature given to it depends of course upon the position of the third roller, which may be varied so that each plate or bar may fit the preceding.

The blocking apparatus consists of a bed concaved to the curve to be given to the plate or bar, and of a block convexed to correspond. On either side of the bed are two uprights which carry a cross-piece. To the centre of the top block is attached a guide-rod, which carries a stud, that slides in a curved slot in a metal plate. The top of the slotted piece is keyed upon a pin passing through the centre of the cross-piece, to which also one end of a long lever is attached. Fastened to the guide-rod, beneath the slotted piece, and in immediate contact with the outer and lower edge, is a friction roller. The lever, on being raised up, causes the slotted piece to describe a curve in an upward direction, whereby the top block is lifted up through the medium of the stud upon the guide-rod. The plate or bar to be bent is then placed in the concave bed, the lever pushed down and with it the slotted plate, which, in consequence of its outer edge acting upon the friction roller, forces the block down upon the plate or bar into the concave bed.

Claim.—The arrangement and combination of mechanical parts before described.

THOMAS HUNT BARBER, King-street, Cheapside. *For improvements in machinery for sawing wood.* Patent dated June 1, 1848; specification enrolled December 1, 1848. *Claims*—

1. The means of giving support to timber when being sawed to various bevels.

2. The improvements in chucks or apparatus for holding timber at the ends when being cut or sided.

3. The means of giving motion to the timber to facilitate its being cut to the bevels.

4. The improvements in sawgates or frames.

5. The means of moving the bevelling bar or apparatus for governing the bevels.

6. The mode of giving stability to the head blocks for holding the logs when being sawn.

7. The apparatus for indicating the directions, or bevels, of the timber to be cut.

RICHARD CHRISTOPHER MANSELL,—Grange-road, Surrey, Gentleman. *For certain improvements in the construction of vehicles used on railways or on common roads.* Patent dated June 1, 1848; specification enrolled December 1, 1848.

These improvements consist,

Firstly. In several modes of applying "elongating springs" to the support of vehicles and relief of concussions, and in a means of rendering them more or less susceptible of vertical motion, or, in other words, easier or more rigid at pleasure. The springs are made of one or more bars or flat plates of steel, or other suitable material, and of a curved, or corrugated, or eliptic form, with eyes or loops for their attachment made at each end; and they are attached in such manner, without any transverse bearings, so that the tensile strain or shocks to which they may be subjected, shall be received from their ends, and cause them to alter their figure in the direction of a straight line, and elongate in the distance between the two ends; the elasticity of the steel, or other material of which it is made, causing it to resume its original configuration on the strain or shocks ceasing. The patentee describes eight modes of applying these springs; but, as they extend over three and a half skins of parchment, and require twenty illustrative figures, we can only give the first:—To the sides of the sole of the railway carriage are firmly secured radial suspension irons, with their centres directly over the centres of the bearings of the axle-boxes. The legs of these irons form the guards for the axle-boxes, and are stayed together in the usual way at their lower ends. The curves of the suspension irons are made with a number of holes, in which are hinged the outside ends of the springs, by bolts passing through them, which allows of making the vehicle more or less susceptible of vertical motion. On the top of the axle-box is a metal bearing, having jaws standing upwards, into which is hinged the barrel-head of an adjusting screw, the round part whereof is screwed throughout its whole length, and furnished with two nuts, one with sufficient surface to have the weight of the vehicle suspended thereon, and the other as small as may be for the purpose of a check-nut. The inside ends of the springs are connected by means of a wrought-iron plate, through the centre of which, the screw part of the adjusting screw passes freely, and rests upon the face of the large nut. This arrangement allows also of adjusting the height of the vehicle, by turning the nut up or down.

Secondly. In several (three) modes of applying these springs to vehicles as buffer and traction springs, for the purpose of imparting elasticity and relieving concussion when such vehicles suffer collision, and further, for relieving the jerks of an unsteady tractive power. To the centres of the two end cross bars of a railway carriage underframe are bolted flat guide plates of wrought iron, which are furnished with stop shoulders to receive the pressure of the spring coupling plates. In the stop parts of the middle guide plates, and in a line with each of their cross connections, are riveted the inner ends of two pairs of radial levers, so as to allow them to turn as on a pivot, while their outer ends are connected to the free ends of two elongating springs. To the under part of each coupling plate is a step-piece, which travels between the flat guide plate. Portions of the levers project beyond the spring attachments, and are kept in constant contact with the inside ends of the buffers. The shock will thus be received on the outside ends of the levers, which will be thrust backwards, and cause the springs to elongate.

The traction arrangement is the reverse of the preceding.

Thirdly. In certain combinations in the construction of wheels for use on railways or common roads, by which they are rendered softer and more economical than those hitherto used. This last part of the invention refers to the constructing of expanding wheels, so that the tyres may be fixed on in a cold state, and the strain equally distributed and properly regulated; and to a method of securing tyres without holes being made in them, whereby they are less liable to fracture. On the cast-iron boss of a railway wheel is tightly shrunk a wrought iron hoop, in both of which are right hand screw holes to receive the lower ends of the spokes, also screwed to fit. The

upper ends of the spokes are threaded with a left-hand screw, and fit into iron shoes, tapped with a left hand screw to suit. These shoes are furnished with flaps to receive and hold fast the inner periphery of the wheel, which is of any suitable wood. The tyre is formed of wrought or cast iron with a groove on each face, near and parallel to its inner edge, and into which fit the flanges of securing rings. The wheel is put together by first screwing up the wooden periphery so as to allow of placing it within the tyre, and then screwing it out so as to press tightly against the inside circumference of the latter, and subsequently fitting the flanges of the securing rings into the grooves of the tyre, and bolting them to the shoes and wooden periphery. *Claims :—*

1. The construction of vehicles having elongated springs adapted and applied thereto, in such manner as that the action of the weight or force produces a tensile strain tending to straighten the springs.

2. The construction of vehicles having elongating springs adapted and applied as buffer or traction springs in such manner as that the concussion or impact shall produce a tensile strain tending to straighten the springs.

3. The construction of vehicles with wheels having the several parts held together by circular flanged plates, or rings of iron, and right and left-hand screws in combination, as described.

JOSEPH WHEELER ROGERS, Nottingham-street, Dublin. *For certain improved methods and machinery for the preparation of peat as a fuel, and in the combination of certain substances as a compost or manure.* Patent dated June 1, 1848; specification enrolled December 1, 1848.

The invention sought to be secured under this patent refers to the drying of peat for fuel, which, when reduced to charcoal, is peculiarly applicable to the manufacture of metals, forge fires, mouldings, &c., and as a mixture with animal excrements, by which they are deodorized, and the ammonial gases, &c., chemically retained.

The patentee proposes to ascertain, firstly, the natural outfall of the bog, and then to cut the peat turf from it in trenches, and in such manner as to effect, at the same time, the drainage of the bog. The lumps of turf, being cut of the proper size, are piled on open trays in moveable sheds, which are fitted with handles or wheels to facilitate their transport. The sheds are furnished with a top of any waterproof material, which, in case of need, may be allowed to hang down all around the pile of turf, to shield it from rain. The turf is thus left to dry for several days, or it may be removed to a shed, and there artificially dried. The shed is provided with an ash-pit extending its whole length, and has its sides made with louvres. Over the ash-pit is placed the heating chamber, which is of a pyramida form (as preferable to any other), and furnished with wheels running on rails laid alongside the ash-pit. Iron perforated plates are placed over the heating chamber, and at a certain distance therefrom, to prevent the peat from coming into contact with the sides thereof. A chimney is fitted to the shed, and is made to slide up and down (to allow of the passage of the heating chamber) underneath. It is provided with a casing, to keep the heat from touching its surface. The chimney is furnished with an apparatus at top, to prevent the escape of smoke and the passage of a current of air, and, consequently, to extinguish the fire. The hot-air passage (that is, the space between the heating chamber and the perforated plates) is furnished with doors, and the heating chamber with dampers for regulating the fire. The peat is piled up over the perforated plates and around the chimney casing; and the chamber is filled with peat, which is ignited from below, and the chimney let down into it. Air is admitted into the hot-air passage, which, after being heated by contact with the sides of the chamber, escapes through the perforated plates, and circulates through the turf. To facilitate the piling of the turf, the louvre sides of the shed are propped up so as to form a kind of stair for the workman, which may be let down after this operation is completed. When the peat is sufficiently dried, and it is deemed desirable to stay combustion, the chimney is closed, and the charred peat raked out into the ash-pit. It will be seen that, by the preceding method, peat charcoal will be obtained, and peat dried for fuel at the same time.

Instead of this arrangement, the shed may be made to contain several heating chambers, with their adjuncts, so as to dry several stacks of peat turf at the same time; or the hot air may be driven by a fan-blower out of hot-air passages through the perforations in the plates.

An apparatus for compressing the peat is next described. It consists of two standards, which carry upon a common axle two wheels, having quadrangular bottomless moulds projecting from their peripheries. These standards are fitted with shoulder-pieces, which project underneath the moulds of each wheel, and serve as a bottom and support to each mould as it passes over them. An oscillating beam, suspended in the frame-work, carries two plungers, which take alternately into one of the moulds of each wheel as they arrive upon the shoulders. The moulds are made

with lips to guide the plungers. On motion being imparted to the machine from any prime mover, and the moulds filled with turf by hand, they are successively brought by the rotation of the wheels upon the shoulder-pieces of the standards, when the plungers fall down into them and press the turf into shape. An improvement in this machine consists in making passages or channels in the shoulder-pieces, to lead into an exhaust cylinder, the piston of which is raised as the plunger descends; so that when the mould is brought upon the shoulder, the air and moisture are exhausted from the peat while the plunger is pressing it down.

The manure is prepared by mixing peat charcoal, previously ground, with animal excrements in the proportion necessary to retain the gases in the mixture and to deodorize it. *Claims:—*

The moveable sheds, so constructed as to protect from wet the peat piled upon the tray, without, however, intercepting the free circulation of the air among the blocks of peat to dry them.

The sheds arranged as described, whether adapted to dry one or more clumps of turf.

The heating, or peat charring chamber.

The hot air passage alone, or combined with a fan blower.

The peat-compressing machine alone, or with the exhausting apparatus.

The application of granulated peat charcoal to animal excrements, in such quantities as to retain the ammonical and other gases in the compounds, and render them inodorous and applicable as manures.

Benjamin Lathrop, of King-street, Cheapside, Esq. *For an improved wheel for railway purposes.* (Being partly a communication.) Patent dated June 6, 1848; specification enrolled December 4, 1848.

For the details of the Specification, see *ante*, p. 563.

Claims.

"*Firstly.* Wheels of cast-iron of such a form that the part equivalent to the spokes of a common wheel, and which I call the disc, shall be corrugated in concentric circles on the plane of the wheel's motion, and at the same time in the line of the radii on a plane at right angles to that plane.

"*Secondly.* I claim the combination of the double corrugated disc mentioned in claim 1, with projections above described as the second form of disc.

"*Thirdly.* I claim the combination of a disc corrugated on radii in the plane of the wheel's motion, with projections described as the third form of disc."

William Brindley, Birmingham, manufacturer. *For improvements in the manufacture of articles of papier maché.* Patent dated June 6, 1848; specification enrolled December 6, 1848.

These improvements refer, firstly, to the manufacture of ornamental and other surfaces of articles in papier maché; secondly, to the manufacture of washhand basins of papier maché; and, thirdly, to the manufacture of hats of the same material.

The method of producing ornamental surfaces, consists in engraving the sunken portions of the mould employed to give configuration to the articles in papier maché, so as to produce upon their surfaces designs in relief. These articles, instead of being japanned, are saturated with oil, and stoved. To obviate the necessity of employing more than one metal mould, and thereby to effect a saving in this manufacture, the patentee proposes to make moulds in papier maché from one of the finished articles, and afterwards to harden them by saturating and stoving.

The basins are made by placing a thickness of pulp between two moulds of the requisite form, and subjecting it to the necessary degree of pressure and heat, after which it is saturated with oil, and stoved; and, lastly, painted with white or other paint, instead of being japanned. The smell of the paint may be removed by subsequent exposure to a sufficiently high temperature for that purpose.

Hats are made by the same process, the form of the mould only being varied.

Claim.—The mode of manufacturing articles in papier maché before described.

Richard Barnes, Wigan, Lancaster, gas engineer. *For certain improved apparatus for manufacturing gas for illumination; part of which improvements is applicable to retorts for distilling pyroligneous acid, and other similar purposes.* Patent dated June 6, 1848; specification enrolled December 6, 1848.

This invention refers to the manufacture and distillation of gas from coal for small consumers, and consists in the construction and arrangement of the stove and retort, the mouth of which is closed by a cover, rendered gas-tight by a water-joint; and in the peculiar construction and arrangement of the refrigerator, condenser, wash vessel, purifier, and gasometer; and, lastly, in the application of the water-tight joint to close the mouths of retorts used for distilling pyroligneous acid and other purposes.

The stove is built of fire-brick, with openings in the front or in the side, but without grate or bars. The retort is suspended in the stove by its flanges, which rest upon horizontal iron supports let into the brick-work, and to which is attached a circular iron plate standing upwards.

The cover is formed with two rims, one

within the other. The inside one takes into a groove formed by the projection of the retort above the flanges and the circular iron plate, while the outside rim dips into another suitably-formed groove, filled with water, and supported from the brick-work of the stove. The circular iron plate passes up between these two rims, so as to intercept the radiation of heat from the inside one, and consequently to prevent the evaporation of the water contained in the groove in which the outside rim dips. The tar, &c., which drips from the cover into between the projection of the retort and the inside rim, together with the water-joint, will, it is stated, effectually prevent the escape of gas into the atmosphere.

Inside the retort is the cradle for holding the coal from which the gas is to be evolved. The gas passes from the retort through a pipe (fitted into the cover) into the refrigerator, the hydraulic main, the condenser, the wash vessel, the purifier, and lastly into the gasometer. The peculiar construction and arrangement of these different apparatus would require engravings to be intelligible. It may, however, be remarked, that they are so combined together as to present a compact appearance, and occupy as small space as possible. The gasometer is telescopic, and contains the purifier, the advantage of which latter arrangement is, that the gas is constantly exposed to the action of the lime. The mode of working is as follows:—The stove is heated to red heat, when the retort containing the cradle is placed in it, and the cover put on. The gas, as it is evolved, passes through the different apparatus into the gasometer; and when the coal is exhausted, the cradle is taken out, and placed in an extinguisher, so constructed as to prevent the admission of air to the coke, and also the escape of noxious vapours from it

The second part of this invention consists in the application to retorts used for distilling pyroligneous acid, and other similar purposes, of the cover, made gas-tight by the water-joint, as before described.

Claim.—1. The constructing the stove with openings in front or in the sides, but without grate or bars, and in closing the mouth of the retorts used in the manufacture of coal gas, or pyroligneous acid, or other similar purposes, by a cover made gas-tight by a water-joint, as before described.

2. The peculiar construction and general arrangement of refrigerator, condenser, wash vessel, purifier, and gasometer, as described.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Jonah Davies and George Davies, of the Albion Iron Foundry, Staffordshire, iron founders, for improvements in steam engines. December 2; six months.

Robert Burn, of Edinburgh, for an improved roller gin, used in separating the seed from cotton. December 2; six months.

Francis Hastings Greenstreet, of Liverpool, engineer, for certain improvements in hydraulic engines. December 2; six months.

John Armstrong, of Edinburgh, brass founder, for improvements in constructing water-closets. December 2; six months.

George Armstrong, of Newcastle-upon-Tyne, Esq., for certain improvements in steam engines. December 2; six months.

Frederick Collier Bakewell, of Hampstead, gentleman, for improvements in making communications from one place to another by electricity. December 2; six months.

William Young, of the firm of Henry Bannerman and Sons, of Manchester, merchants, for certain improvements in machinery or apparatus for winding, balling, or spooling thread, yarn, or other fibrous materials. December 2; six months.

Robert Nelson Collins, of Oxford-court, Cannon-street, druggist, for certain improved compounds to be used for the prevention of injury to health under certain circumstances. December 2; six months.

James Taylor, of 15, Furnival's-inn, gentleman, for improvements in propelling ships and other vessels. December 2; two months.

John Henderson Porter, of Adelaide-place, London Bridge, engineer, for an improved mode of applying corrugated iron in the formation of fireproof floors, roofs, and other like structures. December 2; six months.

John Duley, of Northampton, iron founder, for certain improvements in the construction and arrangement of stoves for cooking and other purposes. December 2; six months.

Thomas Drayton, of Regent-street, practical chemist, for improvements in silvering glass and other surfaces. December 2; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Dec. 1	1690	E. Slyn and W. Green,	Wolverhampton	Cabin door lock.
4	1691	Captain H. Mangles Denham, R.N.	Senior United Service Club, Pall Mall	Tiller.
5	1692	Joseph Paulding	Robert-street, Hampstead-road,	Apparatus for applying steam and vapour heat to parts of the human body.
„	1693	James Hayes	Elton, Huntingdonshire	Pedo-manu-motive.
6	1694	Thomas Barr	Glasgow	Duplex block for printing yarn in the hank.
7	1695	John Gedge	Wellington-street, Strand	Safety hammer for the locks of percussion fire-arms.
„	1696	Henry Smith & Thomas W. Ashby	Stamford	Agricultural cart.

Advertisements.

NOTICES TO CORRESPONDENTS.

A stamped edition of the Mechanics' Magazine, to go by post, price 4d., is published every Friday, at 4 o'clock, p.m., precisely, and contains the Claims of all the Specifications Enrolled, New Patents sealed, and Articles of Utility registered during each week, up to the time of going to press. Subscriptions to be paid in advance. Per annum 17s. 4d., half-yearly 8s. 8d., quarterly 4s. 4d. Post-office Orders to be made payable at the Strand Office, to Joseph Clinton Robertson, of 166, Fleet-street.

CONTENTS OF THIS NUMBER.

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MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1323.] SATURDAY, DECEMBER 16, 1848. [Price 3*d.*, Stamped, 4*d.*

Edited by J. C. Robertson, 166, Fleet-street.

MESSRS. WANT AND VERNUM'S PATENT OSCILLATING STEAM-ENGINE.

Fig. 2.

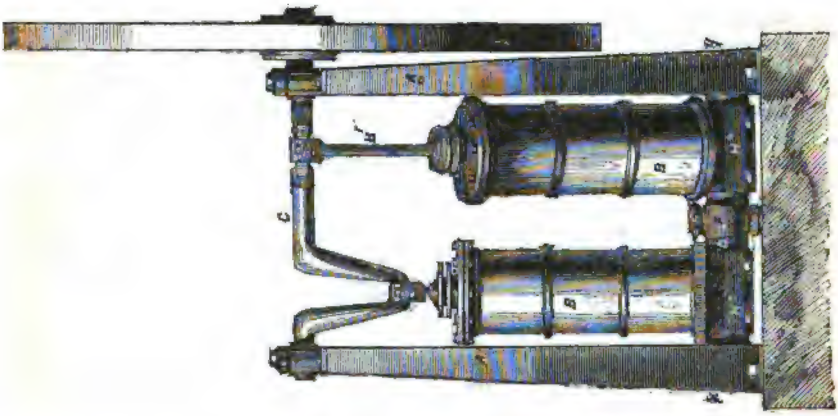
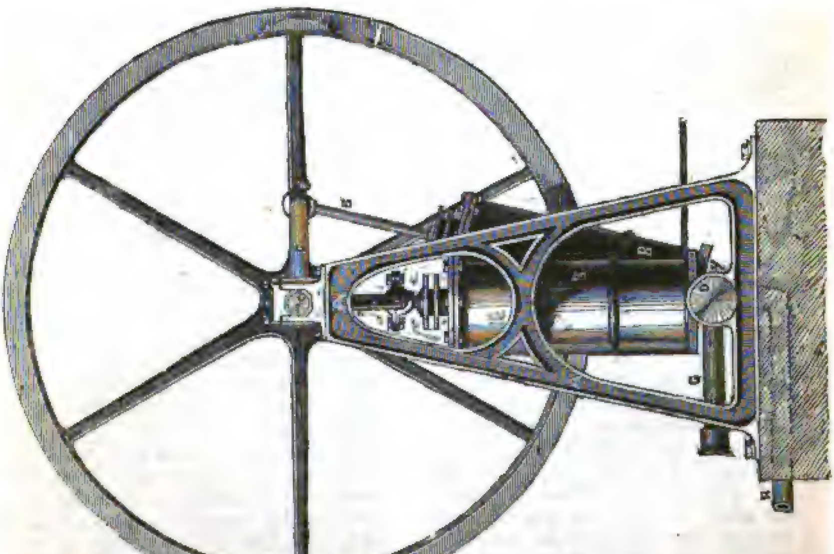


Fig. 1.



MESSRS. WANT AND VERNUM'S PATENT OSCILLATING STEAM-ENGINE.

[Patent dated June 10, 1848. Specification enrolled December 10, 1848.]

The peculiarity in the oscillating system of action patented by Messrs. Want and Vernum consists in centring the cylinders at their under ends (instead of at the middle as usual) upon transverse hollow trunnions, through which the steam is inducted and discharged. Three exemplifications of this mode of construction are given. The first is a double cylinder, or non-condensing high-pressure engine; the second, a single cylinder condensing engine; and the third, a high-pressure locomotive engine. The great simplicity of these engines, the fewness of their parts, and the small space they occupy, are all circumstances much in their favour. Whether the two first, which are worked vertically, will answer as well for large as for small powers, may be doubted; but that they will prove exceedingly efficient within moderate limits—say from two to twenty horse-power—we have no doubt. In the third case, the heavier the locomotion, the more suitable would an engine of this kind be.

The Double Cylinder High-pressure Engine.

Fig. 1 is a front elevation of this engine, and fig. 2 is a side elevation of the same.

AA is the framework; BB are two vertical cylinders which oscillate on their bases, that is to say on a hollow transverse bearing, or trunnion, D, with which they communicate at bottom. B^1B^1 are the piston-rods, which are attached at top to the crank-shaft, C, which is in a line parallel with the under bearing, D. The cranks are placed at right angles to each other, so that the piston of one cylinder may be passing through the most effective portion of its stroke while the other is at its dead point. The hollow transverse bearing, D, is divided into two sets of passages, *aa* and *bb*, as represented in fig. 3, which is a horizontal section of it on the line, *xy*, of figs. 1 and 2, and in fig. 4, which is a plan of the same. F, is a six-way cock which occupies the centre of the bearing, D, and through which steam may be admitted from the pipe, G (which communicates directly with the boiler) into either of the sets of passages, *aa* or *bb*. The openings in the plugs are so arranged that when the passages, *aa*, are in communication with the steam-pipe, G (as represented in the engraving), then the passages, *bb*, communicate with the opening, *c*, in the plug of the cock, F, which opening leads directly to the exhaust pipe, H. Fig. 5 is a vertical section on the line, *ab*, of fig. 3, showing the passages for the steam through the plug, F^1, of the cock, F. All round the plug there is a hollow groove, *d*, cut, which comes immediately opposite to the opening of the steam pipe, G, so that the steam has free access into that groove at all times. From that groove the steam passes into a chamber, *e*, formed in the upper part of the plug, from which chamber it flows through the openings, *ff*, into the passages, *a a*. By referring to the horizontal section, fig. 3, of the trunnion, D, it will be seen that when the two passages, *ff*, of the cock coincide with the passages, *a a*, of the trunnion, D, then two of the other four passages or openings, *g*, *g*, *g*, *g*, which are in the plug, F^1, must coincide with the two passages, *b b*, of the trunnion, and allow the steam to escape from the cylinders into the exhaust pipe, H.

Each of these passages, *a a*, terminates at the end of the trunnion, D, in a bend, so that it may communicate with the two outside ports, *h h*, while the other passages, *b b*, terminate in the mid ports, *i i*, which are placed directly beneath the lower ends of the cylinders, A A, with the steam-port facings of which they exactly correspond.

In fig. 6, which is a vertical section of one of the cylinders, and the parts immediately belonging to it, the cylinder and piston rod are represented in the position which they would occupy at the commencement of the stroke of the piston. In fig. 7, which is another vertical section of the same parts, the cylinder and piston are represented as at half stroke, and the ports and passages in such relative positions that the steam shall pass in beneath the piston from the left-hand side of the passage *a*, of the trunnion, through the port *h*; while, at the same time, the exhaust passage, *b*, is open for the escape of steam from above the piston by the steam passage, or port,

Fig. 3.

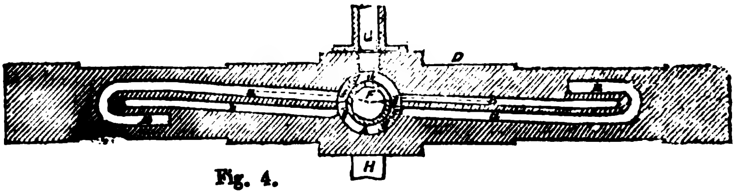


Fig. 4.

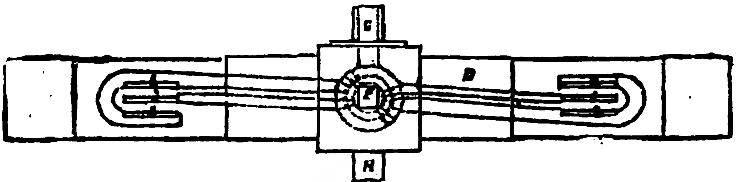


Fig. 5.

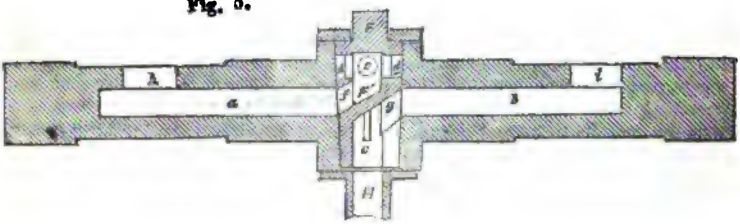


Fig. 6.

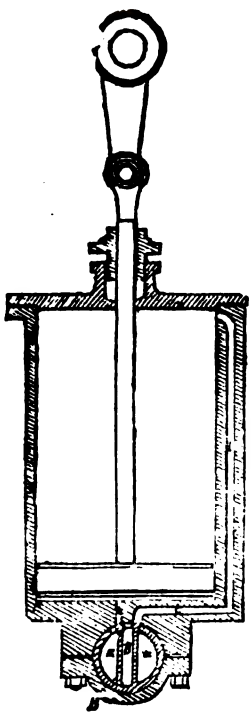
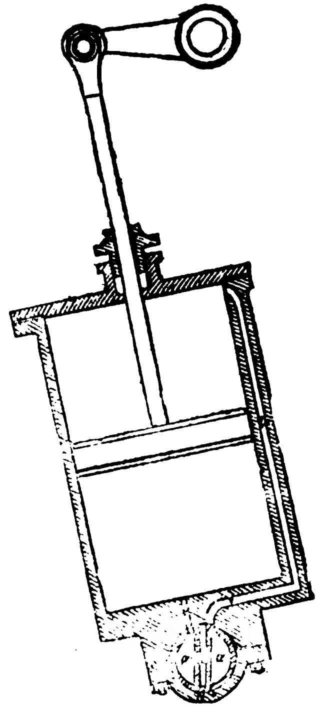


Fig. 7.



l. At the termination of the stroke the ports become entirely closed to each other, as represented in fig. 6. The moment however the crank passes the centre, the cylinder becomes inclined to the opposite side, and the right-hand side of the passage *a*, is then opened for the admission of steam to the top of the cylinder, while the bottom of the cylinder is thrown open to the exhaust pipe. And thus the working of the engine goes on continuously.

A great advantage gained by having the trunnion at the bottom of the cylinder, instead of at the centre, as in oscillating engines generally, is that the piston rod makes a much less angle with the crank shaft, and thereby throws less strain upon the framing, and is consequently productive of much less friction. Again; the relative positions of the ports and steam passages afford greater facility in reversing the engine, because the moment the cock F, is turned round, so as to bring the openings, *f f*, opposite to the passages, *b b*, in the trunnion, D, then the passages, *g g*, are in connection with the passages, *a a*, which renders the latter, for the time, exhaust passages, while the others, *b b*, become steam passages; which at once completes the arrangement for reversing the motion of the engine.

The port facings upon the bottoms of the cylinders are kept in contact with those in the trunnion by means of the glands, H^2 H^2, which, together with the cylinders are truly bored out, so as to fit the trunnion. When any slackness arises from wear; this defect can easily be rectified by screwing up the bolts connecting the glands to the cylinders.

The Single Cylinder Condensing Engine.

Fig. 8 is a front elevation of this engine, and fig. 9 is a side elevation of the same. AA is the framing; B, the cylinder; C, the hollow trunnion upon which the cylinder oscillates; D, the steam supply pipe; F, the exhaust pipe; E, a cock which opens and closes the induction and eduction passages, and is of a similar construction to the six-way cock before described, the only difference being, that as there is but one cylinder to this condensing engine, so there is but one-half the number of ways required in the cock. *s* is the condenser; H is the air-pump, which communicates with the condenser through a three-way cock, I, exactly like the steam cock, E. The air-pump also is nearly in every respect constructed in the same way as the steam cylinder, B, oscillating at its base upon a hollow trunnion, F^2, the passages in which serve all the purposes of the valves ordinarily used.

The Locomotive Engine.

In this case, Messrs. Want and Vernum propose to employ two pairs of cylinders, each pair consisting of two cylinders connected end to end together, and the two pairs being centred on the opposite ends of a transverse hollow trunnion, on which they oscillate, as also two air-pumps, one to each pair of engines. The reason of an arrangement of this sort being more especially applicable to heavy locomotives, is, that the weight of the one set of cylinders would act as a counterpoise to the opposite set, and thus throw the whole weight of the cylinders upon the trunnion, leaving the crank pins and piston rods entirely free from the load, which is generally thrown upon those parts, by oscillating engines of the ordinary description (when such are used).

For the efficient working, however, of Messrs. Want and Vernum's engines in this locomotive application of them, it will obviously be necessary that in connecting the two cylinders together of which each pair consists, their centre or axial lines should be in the same straight line, and that the bearing for the trunnion should be bored out at right angles to the same line.

When the bearings of the axles of the wheels of the locomotive are rigidly affixed to the frame of the carriage, then the cylinder trunnion must be also securely affixed to the framework; but as the bearings of the wheel axles are generally allowed some latitude of play up and down in the framework to which they are attached, through the medium of springs, it will also in such case be necessary to give the trunnion and cylinders a corresponding play vertically, because if any of the wheels should be raised up from any unevenness of the rails or occasional obstruction, the raising of the wheel would be apt to bend or break the piston rod. Messrs. Want and Vernum, therefore, allow the trunnion

to have such a degree of vertical play as may suffice to prevent such accident; and this they accomplish by placing the trunnion in slotted bearings, which are attached to the framework. These slotted bearings are provided with helical springs above and below the trunnion, to prevent its working up and down except

Fig. 8.

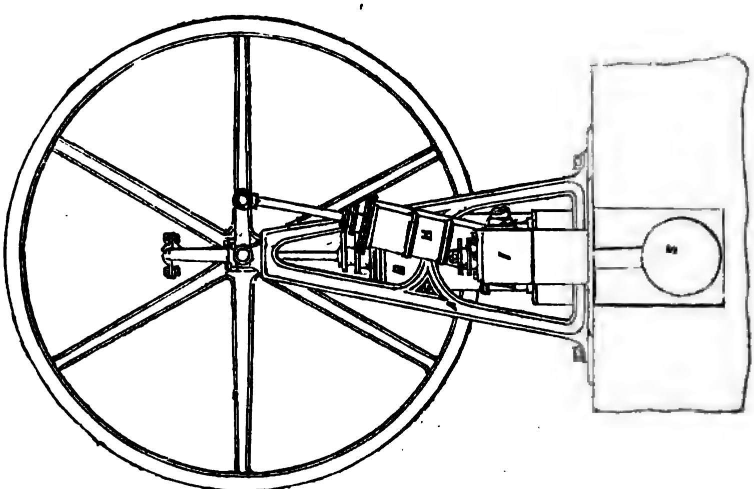
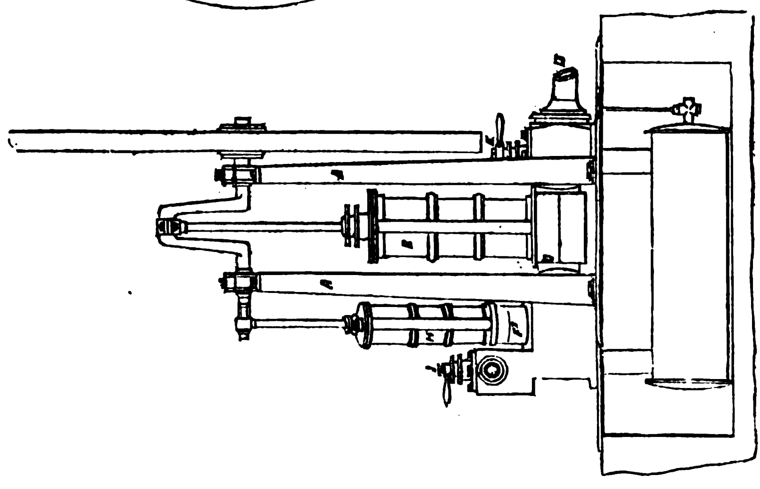


Fig. 9.



when it may be necessary for it to do so. The steam pipe connecting the boiler with the trunnion, is provided with a packed telescope joint, which admits of the pipe lengthening or shortening, according as the trunnion is removed, further from or nearer to, the boiler by the vertical play which is allowed to it in the bearings.

A light class of locomotive engines

might be constructed with one pair of single cylinders, one cylinder on each side. Or, again, instead of having a second cylinder upon the opposite side of the trunnion, a single cylinder at one end only may be used, with a weight at the other end to counterbalance it.

In locomotive engines of this sort, the hollow trunnion of the cylinders should always be permanently and securely fixed to the framework, as it is not necessary that it should yield along with the side bearing of the wheel to which the piston rod is attached.

Claim.—We declare that what we claim is the improved engine before described, in so far as regards the manner in which the cylinders are centred on and communicate with the hollow trunnion, and the mode in which the said trunnion is internally constructed, and whether the said engine is actuated by steam, air, or any other fluid.

MECHANICAL PRINCIPLES OF BUILDING, RIGGING, AND EQUIPPING SHIPS FROM THE UNPUBLISHED PAPERS OF THE LATE BRIG.-GEN. SIR SAMUEL BENTHAM.

[To the application of the principles of mechanics in the structure of navigable vessels, may be attributed the great improvement in the strength of their hulls —particularly those of iron—which has taken place during the last half century: by an application of those same principles, much might also be done to increase the strength, efficiency, and economy of the *rig* of vessels. It appears from the *Mech. Mag.*, vol. xliii., p. 186—189, that mechanical principles were first systematically applied to ship building by the late Brigadier-General Sir Samuel Bentham, in the construction of his experimental vessel, 1795; but in that statement of the peculiarities of those vessels, no mention is made of their sailing appliances. In point of fact, however, in one of those vessels, the *Arrow*, several innovations were introduced in her masts and rigging, a short enumeration of which may possibly excite attention to the subject, and lead to vast improvement in this branch of naval outfit. It may not be irrelevant to observe, that at the end of the last century, naval officers were less disposed to admit of change in respect to the rig, than even as to the form and construction of the hull, so that perseverance in attempts to improve the sailing apparatus was forborne; but of late this adverse disposition appears to be giving way to more enlightened views, as is evidenced, for example, in the masting of the *Great Britain*, and in the general tendency of the evidence given by Lord John Hay before the Select Committee on Navy, Army, and Ordnance Estimates.

But besides those improvements in the rig of the *Arrow*, which tended to its efficiency, the introduction of an important principle in economy was in her first exemplified—the principle of *inter-convertibility*. This example has been altogether neglected till of late; now it appears from the minutes of that same evidence, that this principle is at last taken into consideration, and is affirmed both by Lord John Hay, the naval Lord of the Admiralty, and by Sir Baldwin Walker, the surveyor of the navy, to be of immense importance as to saving of expense in the *materiel* of the navy.* So also, in the Appendix to the Committee's Report, it appears that Mr. Murray, chief engineer of the factory at Portsmouth, in recommending that all the screwing-apparatus in the dockyards should be made uniform, added that, "A uniformity of taps and dies throughout the whole country has already engaged the attention of engineers generally, a proposal for it having originated with the late Mr. Maudslay, and having been since canvassed with very general approval."† This principle, whether under the appellation of uniformity, classification, or of the more comprehensive term, inter-convertibility, seems now acknowledged to be applicable to engineering and manufacturing purposes, as well as to those of the navy. The evidence on this subject of Lord John Hay and of Sir Baldwin Walker, being in detached replies to various queries, and differing nothing from that of Sir Samuel Bentham, as given in writing, April 5th, 1798, to the Select Committee on Finance, it does not seem out of the way to quote his evidence, as explanatory of his views in contriving the rig of the *Arrow*. This

* Minutes of Evidence taken before the Select Committee on Navy, Army, and Ordnance Estimates, page 164.

† Appendix to the Report from the Select Committee, page 929.

report was submitted to the Admiralty Board, is on record in their office, and was presented to the Committee with their Lordships' approbation. We begin our selections from Sir Samuel's papers on this subject, with an extract from the Report referred to.]

Extract from Report of April 5, 1798.

But such are the accidents to which vessels at sea, particularly vessels of war, are liable, as to render it impossible but what certain articles should occasionally be renewed; for this purpose a great deal of space on board ship is taken up by the stowage of spare articles of various kinds, ready prepared; and distant establishments have been formed, chiefly for the purpose of supplying what the ships themselves are incapable of carrying. A due attention to past exigencies may, no doubt, do much towards adjusting the comparative quantity of these stores in the most advantageous proportions: but, even supposing these arrangements thus far perfect, the articles liable to become unserviceable are so various, and some of them so bulky, that it is impossible to carry so much as a duplicate of each; as, for example, to say nothing of the lower masts, the spare topmasts, or even the sails, so long as each differs from the other in dimensions, if stored on board in sufficient quantity, to supply the reiterated demand likely to occur for these articles, would be sufficient to fill the ship.

But in and belonging to a ship there are a great many different articles which, without rendering any article less fit for its use, might be made perfectly similar to each other, or, at least, so nearly so as to be capable of being employed each in the place of the other; by which means two spare articles in store, applicable to seven or eight different purposes, might, in the event of an accident happening twice to the same subject, form a more valuable supply than if duplicates only had been provided for each of those seven or eight articles.

This similarity, considered as an expedient enabling a vessel to remain longer on its station, was introduced in some instances on board the *Arrow*. Of the three lower masts, two were made alike; the topmasts were all four alike (for there were two to the mainmast, one above the other); the three top-gallant masts were all alike; studding-sail booms were alike; five of the principal sails were either perfectly alike, or by a very easy addition or separation capable of supplying the place of each other.

These instances of *inter-convertibility* among the articles of store, trifling as they may appear in the instance of a single ship, and that a small one, may serve to give an idea of a principle, which, if kept in view among other considerations at the time of proportioning the different classes of ships, as well as the different parts or appendages about a ship, may not only enable ships at sea to possess within themselves a much more efficient supply, but may enable a much less expensive stock to suffice for our storehouses at home, and afford the means of effecting a still more important reduction in the expense of our naval establishments abroad.

[The particulars above specified are not repeated in the following enumeration of the peculiarities of the *Arrow's* rig, excepting when some farther elucidation seemed desirable:]

Peculiarities of the Arrow *in respect of Rigging.*

Masts.

The mainmast farther forward than in the present mode, being in the middle instead of abaft the middle of the length of the vessel. By this innovation, in case of the loss of the foremast, or the mizenmast, or of both, the mainmast being then the only one carrying sail, the vessel would be more governable having the mainmast right in the middle than if abaft the middle, as at present.

In the proportion of sail between mast and mast, the quantity on the foremast was less than usual; that on the mainmast much greater than usual. By this and the preceding arrangement, the greatest quantity of sail, and thence the greatest force upon the vessel, is thus brought to that part of her length, which, by reason of her breadth, affords the most efficient means of support. By the increase of sail on the mainmast, greater celerity was obtained in sailing before the wind, as in sailing in that direction, the quantity of sail on that one of the masts which carries the greatest spread of sail, is the quantity by which alone the rate of sailing is determined.

The bowsprit much shorter than usual. The office of the bowsprit having in the *Arrow* been in part performed by the extra projection given to the bow of the vessel, the demand for length of bowsprit was so much the less; and the lever with which the bowsprit acted to separate itself from its place of insertion being so much shorter, the bowsprit was so much the less in danger of being carried away by accident, and its shortness rendered it less exposed to be carried away by shot.

The masts shorter without board than in the current mode, the mainmast about 7 feet, the foremast about 5 feet. The centre of

action of the wind on the sails having been so much lower than usual, the greater security thus obtained against oversetting, afforded the faculty of carrying a greater spread of sail without danger. The masts were also shorter than usual within board.

Mastheads longer and larger than usual. The mast in proportion to the increased length of the masthead, gives the greater scarph, and thus affords an additional degree of support to the topmast. So considerable in the *Arrow* was this addition, that supposing the shrouds, all of them, to have been shot away, the support thus afforded to the topmast by the mast alone would have been sufficient to enable the topmast to carry the topsail even in a fresh breeze.

Maintop-gallant-mast stepped upon the mainmast-head; on which account it went up and down on the aft side of the maintop-mast, guided by a hole in the after part of the maincap. The topgallant-mast had thus more than equal to its butt to rest upon, instead of having nothing but a pin (the fid) to rest upon as in the usual mode.

Yards.

Mainyard much longer than usual. The use of this extra length was to adapt the mainyard to the purpose of carrying a greater spread of sail with less hoist than is usual.

Fore and mizen yards of the same dimensions. Fore and mizen topsail yards the same. Fore and mizen topgallant yards the same. All these peculiarities with a view to inter-convertibility.

Tops.

Tops, instead of being of an equal breadth fore and aft, were much broader at the after shroud; the extra breadth aft as great as could be, without throwing the puttock shrouds into such a position as to be in the way of the mainyard when braced close to the wind. Tops of this kind had already been supplied to the two frigates, *La Pomone* and the *Stag*; they were of the invention of Sir Henry Peake;* but in point of structure, those on board the *Arrow* were somewhat different, in consequence of a more mechanical adjustment of their parts, whereby they were rendered of less weight without prejudice to strength.

Caps.

Fore and mizen caps alike. Main, fore, and mizen topmast caps, and maintop gallant caps all alike. These afforded examples of the application of the principle of interconvertibility.

Main topmast cap double, extending abaft the mast as well as before it, and adapted to the receiving equally well, a topmast abaft the mast, as well as before it. Thus in case of the topmast being shot away or wounded, the gallant mast might be lowered down on the aft side of the mast to supply the place of the injured topmast, receiving from the after part of the cap effectual support. Or, a spar might on such an occasion be got up through the aft part of the cap, and thus be lashed to the topgallant mast, in which way the quantity of sail would remain undiminished, and the reparation in some circumstances might thus be more speedily performed, than in the other way.

Perhaps it might be a further improvement if the cap of the topmast were likewise made double, to receive the head of a succedaneous topmast at the aft side of the mast.

Shrouds.

Main topmast crosstrees, none. The shrouds instead of leading to the top-over cross-trees, led straight to the top, in the same manner as the topmast shrouds in the usual mode. This effected economy in first cost and in wear and tear; and the operations to be performed on board were diminished by the omission of much unnecessary incumbrance. The main top-gallant mast head having been at a small height above the maintop, and the maintop so broad, the maintop gallant shrouds, though made to lead directly to the maintop, formed of

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* *La Pomone* and the *Stag*, during about three years that they had these tops, never carried away a single topmast. In the course of this period the *Stag* happened to undergo a trial, the result of which afforded a striking experimental proof of the advantages of these tops. The *Stag* being in company with another frigate of the same construction and dimensions (supposed to be the *Alcmene*) the former by means of her improved top, carrying at the time more sail than her companion, a signal was given to chase. The *Stag* thereupon maintained the same quantity of sail without injury; her companion attempting, in obedience to the signal, to increase her quantity of sail to an equality with that of the *Stag*, the *Alcmene's* topmasts were *all three* of them *carried away*.

These topmasts afford an example of the petty inattentions, owing to which the most promising improvements are condemned. With a view to the obtainment of the advantages in question, tops of this construction were put up on board the *Sans-pareil*; but in this instance the experiment, from want of proper arrangement, failed. The puttock shrouds had not been brought down sufficiently low to enable them to withstand the strain of the topmast shrouds, the crosstrees were sprung; the angle made by the shrouds with the topmast, which they are employed to support, being rendered so much the greater as the top which affords a base to them is broader, and thence the support they give to the topmast so much the stronger, and this more particularly in the instance of the after-shrouds, which have the greatest strain to resist.

themselves with the top-gallant mast, an angle proper for the support of it; thus the intervention of crosstrees, for the purpose of enlarging the angle, became unnecessary.

Puttock shrouds brought all of them as low as possibly they could be, without interfering with the bracing of the yards. By this innovation much security was afforded against injury to the tops from the tension of the topmast and top-gallant mast shrouds, the support afforded by the puttock shrouds against that strain being the stronger, the less acute the angle that they make with the plane of the top.

Braces.

In addition to the main braces which led aft in the usual mode, another set, but of much slighter dimensions, leading forward under the foretop, as in merchantmen. The only reason assigned for the difference in this particular in the Royal Navy from the mode observed in merchant ships, is a notion that a support is thus afforded by the braces to the yard. But though the braces, by reason of their leading aft, afford some support to the yard in the horizontal direction, yet by their pulling downwards, they apply a strain to the yard which seems greater than the support they give to it. The direction given to the additional set of braces being more conformable to the direction in which the yard is made to move, there was this further advantage, that the labour in moving them was less.

Had the operation of bracing the yard about been the only one considered, the set of braces that lead aft would have been omitted, this purpose being answered in a much better manner by those that lead forward; but the purpose for which the braces leading aft have been preserved, is that of affording support to the yard, to which purpose they were better applied in the *Arrow* than in other vessels, in proportion as the *Arrow's* yards were lower, and the mainmast further forward than in other vessels.

Tacks.

The main tack, instead of leading to a chest-tree without side of the vessel, led within the vessel to a block so situated as to enable the foot of the sail to be brought to the same angle as the yard is braced to, when close hauled; whereby celerity in sailing near the wind was obtained.

The inconsiderate and injudicious mode of placing the chest-tree, afforded one instance out of many of the little attention commonly paid on board ships of war to the setting of sails, or the several parts of the same sail, to the same angle; although the importance of uniformity in this respect, cannot fail of being universally acknowledged by every one that reflects upon it. Indeed, upon examination it would be found that it is to that source principally, if not solely, that any superiority possessed by smugglers, or other private vessels famous for quick sailing, might commonly be traced; for in that state of things the rate of sailing depends on the uniform preservation of the appropriate angle of the sails.

The fore-tack, instead of leading to a bumpkin, led to a block on the fore-castle, the sail being so narrow at the foot as not to require any such artificial extension as that which the bumpkin is employed to give. This innovation was principally with a view to avoidance of the not unfrequent accident of carrying away the bumpkin, as also to save labour in getting the tack down.

Sails.

The sails were all of less hoist, in proportion to their breadth than in the usual mode. The courses were all of the same drop. Top sails all of the same hoist. Top-gallant sails all of the same hoist. Main courses, and main-top sail of the same shape and size. Fore courses, fore-top sail and mizen top-sail of the same shape and size. These innovations, all with a view to inter-convertibility; this principle having been carried so far in the cut and contrivance of the sails of the *Arrow*, that one and the same piece was capable of being made to serve indifferently for any one of *ten* places.

The sails of the fore-mast, and that of the mizen-mast were composed each of *two* pieces, meeting in the middle of the spread, and were at that part laced together. The sails of the mainmast were composed of *three* pieces, two of them equal and similar to those of which the sails of the fore-mast, and those of the mizen-mast were composed, the greater spread having been given by the insertion of a middle piece. The studding sails were each of them divided diagonally into two triangular pieces laced together; the lower studding sail in the direction of a line drawn from the lower boom end to the clue of the course: the top-mast studding sails in the direction of a line drawn from the lower boom end to the top-sail yard-arm. By this peculiarity means were afforded of substituting a spar *half* sail in the place of a damaged half sail, instead of applying an entire spare sail to that use, and that in less time.

The masts of both the *Arrow* and the *Dart* instead of being stepped in the hold, were stepped on the platform.

[The following peculiarities not having been included in the account of the experimental vessels given in the *Mech. Mag.*, vol. xliii., are now added.]

The capstand had a circulatory ring of rollers at each place of support, thereby diminishing friction, and consequent saving of labour in working the capstand.

By the direction given to the hawse-holes, the cable, instead of being bent to a sudden angle as usual, was left nearly straight, being almost in a line with the direction the cable is in while the ship is at anchor. The hawse-holes at the stern afforded apertures answering the purpose of row ports.

The pumps, instead of any of the various complicated ones in use, were simple ones, on the principle of the common hand pump, but better proportioned in their parts; they had in their composition less metal than usual, and what there was was copper, or tinned copper, without any iron. It must be evident that the simpler the pump, the greater certainty and expedition with which it can be put to rights in case of accident.

The steering apparatus for communicating the motion from the steering wheel to the rudder was an inflexible cog-wheel, instead of a flexible rope. By this innovation a very superior degree of command over the rudder was obtained.

Extract from an unfinished Naval Essay on the Structure of Vessels for Navigation. By Sir Samuel Bentham.

As to the means of obviating these partial strains, it has been said above that by an apt distribution of the inferior fittings required for various purposes, they may be made subservient to strength of structure. Taking for example the strains on the vessel produced by the masts, and considering that a variety of partitions and receptacles are necessary within board, it should be considered how far any of these may, by their disposition, be made to resist the strains of the mast.

As masts are at present fixed they extend down to the hold, where a mass of timber is prepared to step them upon, with the intention of giving some strength below them as to immediate downward pressure, also some extension of surface over which the strain is extended; but still not spreading the strain over more than a few feet, and not making use of any of the stronger parts of the vessel itself to resist it. But in lieu of this mode, very effectual means of resisting this strain would be found to be obtainable, by a suitable disposition of some of the divisions requisite in the ship for other purposes. Along the middle of the ship, a middle-bulk head* need not to be closed in, although connected with ties longitudinally, and with pillars from deck to deck. In the same manner transverse bulk heads might be placed where the masts have to rest. These bulk heads, whatever the size of the ship, to commence in the hold and be carried upwards to support the deck next under the upper deck. The mast, instead of being carried down into the hold, need, by these precautions, be carried no lower than one deck down, where being stepped upon a crossing of the longitudinal and transverse bulk heads, the weight and strain in as far as depended on the mast itself, would be no longer partial, but be diffused along the whole length and breadth of the vessel.

As to the strain occasioned by the shrouds, the force of which is known to be so great as sometimes even to destroy the very substance of the mast, by crushing the fibres of it, and which of course must act with an equal strain upon the ship itself where the shrouds are connected with it; there seems every reason to investigate what part of the vessel this strain could be extended over, instead of confining it, as it is at present, to the short length of the channels fore and aft, and to the disadvantageous action upon the end of the lever which these channels may be considered as forming, transversely fixed as they are by the inner edge to the ship's side. In this view, the part most competent to resist the strain and to spread that of the shrouds, is along the line of the deck edgewise, when the whole breadth of the deck would be opposed to this force; and further resistance might be afforded were they fastened at the juncture of the bulk-heads with the sides.

* There were middle bulk-heads, as well as transverse ones, in the *Arrow* and rhe *Dart*.

THE SEA-WALL QUESTION.

Sir,—I should not have again obtruded any remarks on a subject which has already been so frequently discussed in the columns of your useful miscellany, I mean the sea-wall question, but as you have honoured my former paper by insertion (No. 1321, p. 537,) I feel confident that you will not think me importunate if I request the correction of an error in the printing of Dr. Hutton's formula for the oblique pressure of fluids. As it appears on the page above designated (col. 2) the formula is unintelligible, except as far as the allusion to it at the end of the paragraph may enable a mathematical reader to guess at the meaning; but, if it should be troublesome to the printer to place the exponent above the line as usual, and as it is in the M.S., the corrected expression may stand

thus: "Sin. θ raised to a *power* whose exponent is denoted by the term 1·84 cos. θ, and the whole multiplied by a." And in this manner your readers are requested to understand it.

Being now on the subject, I beg permission to offer an observation on the valuable paper by Mr. Dredge concerning Mr. Stephenson's experiments on the lateral force of waves, see pp. 538, 539, *ante*. Apparently the writer who in a former paper (*Mech. Mag.*, No. 1313, p. 342) put q for the coefficient of the variable part of the formula representing the pressure against the oblique face of a sea-wall, meant it to signify the actual pressure or force exerted against a square unit of surface, a foot or an inch; and, as its value had nothing to do with the *law* of pressure which was the subject in question, he may not have thought it necessary to mention that value; every person must know that it was a quantity to be determined by experiment; and Mr. Dredge has rightly shown (p. 588) what q is equivalent to, if statical pressure were contemplated. But it is evident that, if dynamical force be understood, the formula nq sin.$^2\,\phi$, or AC q sin.$^2\,\phi$ (conformably to the Note in Sir Howard Douglas's "Protest"). See *Mech. Mag.*, No. 1313, p. 343, will still express the law of pressure against an oblique plane, since mv^2 represents the *vis viva* (m being the mass of the impinging fluid). Now m is constant as well as $\frac{\delta}{2g}$; therefore, for the mere purpose of denoting the diminution of force arising from the obliquity; and as this appears to have been all that was originally contemplated, it is indifferent which expression is used for q.

I hope Mr. Dredge will pardon me, however, if I say that though his two expressions (p. 588, col. 2) for the effect of the waves have the same meaning, yet the second will assuredly lead most practical men to form an erroneous opinion concerning the law of pressure. Such men will not easily perceive that, in comparing the pressures on walls having the same height but different inclinations, AB is variable; and they will, as some have already done, consider that the pressures vary with the cube of the sine of the inclination: now the formula containing AB is an unfinished expression in the investigation; for, by trigonometry, $AB = \frac{AC}{\sin.\,\phi}$ (AC being the vertical height,) and, substituting this value of AB, the second expression becomes identical with the first, in which the coefficient of $\sin^2\phi$ is really constant; consequently, finally, the pressures vary with the *square* of the sine.

I beg now to offer one word on the manner in which Mr. Dredge proposes to estimate the effect of wave action on the *marine dynamometer*. I grant that the pressure on any moving body multiplied by the space moved in a given time, is a convenient measure of power exerted; but it does not express an equivalent of the strain produced on the object pressed, nor the shock produced in an object affected by a sudden impact. It merely enables us to compare together the relative values of the effects produced by different agents, as a horse, a water-wheel, or a steam engine; and the integral of the expression $(f + ax)\,dx$ (p. 539), is the sum of an infinite number of such products during the compression of the spring of the instrument; but I apprehend that such is not the nature of the action which is exerted by sea waves against a wall. Here a series of violent and sudden percussions take place; and these, by loosening the coherence of the materials endanger the work, and may, at length, cause its ruin.

Now, in this case, it seems evident that the object should be to determine the maximum intensity of each wave percussion; and, agreeably to the well-known theorem in dynamics, this takes place at the instant that the compression of the spring of the dynamometer is the greatest. The scale of the instrument being constructed conformably to this principle, comparison being made with the effects produced by the pressure of known weights, it follows that its indications will be what they profess to be, nearly correct values of the *vires vivæ*, or of the forces of impact.

I think the alleged objection (p. 539, col. 1) to the representation of dynamical force by statical pressure, is ill-founded. We have no means of expressing the effect of percussive force but by the dead weight, which would produce an equivalent effect. Thus, if we wish to find the force with which a

hammer strikes an anvil, we use the dynamical formula, which enables us to find the height of a column of iron (and from thence the weight), which would produce an equal compression; and we consider that weight as equivalent to the required force. That formula is founded on a consideration of the effect being produced in an indefinitely short time; and physical science is able to go no further in the difficult subject of percussion.

Mr. Dredge considers the last formula on page 539, as representing the pressure of the waves on each *unit* of the surface of the wall; but AC (the vertical height) entering into it, his meaning is evidently, the pressure on a *lamina* of the wall, whose breadth is that of the unit of surface.

I am, Sir, yours, &c.,

A STEAM SHIP AND WATER-WHEEL ENGINEER.

A PROBLEM RESPECTING THE LAW OF POPULATION. BY J. R. YOUNG, PROFESSOR OF MATHEMATICS, BELFAST.

The following problem on population cannot fail to interest the readers of the *Mechanics' Magazine*. It was sent to me several months ago, by a very distinguished person; and the following solution was returned by the next post. It was proposed as a striking example of the value of the first principles of the integral calculus; by the application of which the problem, though not new, had not, I believe hitherto been solved. Such practical applications of the fundamental doctrines of a knotty subject are well calculated to encourage and stimulate a student to persevere in the inquiry, and it is on this account that I here publish it. If I were at liberty to give the name of the illustrious proposer, the problem would be invested with much additional interest.

Problem.

"P = the population—a function of t the time. dP, the increment of P during dt, will vary as P. Find the equation between P and t, so as that, if we know P, at the beginning of a year, when $t=0$, and P_1 the population at the end of a year, when $t=1$, we may find the value of P after the lapse of t years."

Solution.

It is plain, from the proposed conditions, that

$$\frac{dP}{dt}=CP,$$

$$\therefore \frac{dP}{P}=C dt \therefore \log P=Ct+C_1.$$

Let $t=0$ $\therefore \log P=C_1=\log P_0$, suppose.

$$\therefore \log P=Ct+\log P_0.$$

When $t=1$, $C+\log P_0$ is given $=\log P_1$.

$$\therefore C=\log P_1-\log P_0.$$

$$\therefore \log P=(\log P_1-\log P_0)\,t+\log P_0$$

$$=t\log P_1-(t-1)\log P_0.$$

From this it follows that,

$$\log\frac{P}{P_0}=t\log\frac{P_1}{P_0}.$$

So that, if $P=m\,P_0$, we shall have

$$\log m=t\log\frac{P_1}{P_0},$$

$$\therefore t=\frac{\log m}{\log P_1-\log P_0}$$

When $t=n$, we have

$$\log P_n=n\,C+\log P_0,$$

$$\therefore C=\frac{\log P_n-\log P_0}{n}$$

$$=\frac{1}{n}\log\frac{P_n}{P_0}=\log\left(\frac{P_n}{P_0}\right)^{\frac{1}{n}},$$

therefore,

$$\left(\frac{P_n}{P_0}\right)^{\frac{1}{n}}$$

is a constant quantity.

From this last equation, we may infer, that if the population of a country or province be taken at the beginning, and at the end of a year, when there is little or no reason to suspect that the law is sensibly disturbed by extraneous causes, then the quantity

$$\frac{P_1}{P_0}$$

may be regarded as a standard number or *modulus* with which to compare the number

$$\left(\frac{P}{P_0}\right)^{\frac{1}{n}},$$

furnished by a census taken n years from the aforesaid beginning; the difference between the two numbers will indicate the extent to which the natural law has been disturbed, during the interval, by the operation of accidental causes.

In other words, we may thus deter-

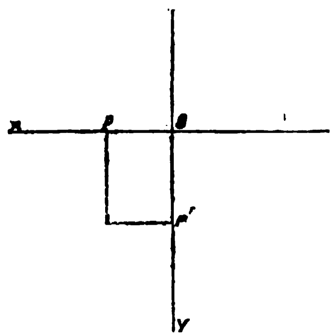
mine what correction should be applied to the rate of increase of the first year, in order that the results of observation of the nth year may conform to the natural law.

Belfast, December 8, 1848.

PLUS AND MINUS.

Sir,—Being a regular subscriber to, and reader of your excellent Magazine, you will perhaps excuse my asking a place in your columns for the following inquiry:

I have read with much pleasure and advantage the papers contributed by your able correspondents, "Ex-Reviewer," "A. H.," "Iatro-Mathematicus," and others: but among them I find no solution of a difficulty, which has often presented itself to me in the course of my reading in Analytical Geometry. It may be briefly expressed thus: Let O be the origin of co-ordinates; OX the axis of x; OY the axis of y; then OP may be represented by $-a$ and OP′ by $-b$; and now, if we perform the common process of multiplication upon these two quantities, we have, as the product, ab.



Whereas, the parallelogram, PP′, appears to me to be, according to the usual mode of applying the symbols of operation (or of position as they are, in reality, in this case), more correctly represented by $-ab$, since the parallelogram, is altogether to the left of OY and below OX. The parallelograms in the other three angles appear to be easily explained, but the frequent recurrence of this fore-named difficulty, to my mind, has led me to suspect I may have misapprehended, even these.

Most elementary treatises on this subject, explain the use of the symbols of operation (or direction) somewhat in this manner:

If the *plus* sign placed before a symbol of magnitude, represent that magnitude taken in *one* direction: the same symbol of magnitude affected with the *minus* sign, will represent the same magnitude taken in the opposite direction with respect to O, which is both reasonable and intelligible. But in this case, we have $+ab$ representing the parallelogram in *one* direction, and also in its *opposite* at the same time. Otherwise, if $-ab$ represent the parallelogram, PP′, and it is formed by the product of $-a$ and $-b$; we have $(-a) \times (-b) = -ab$, which the established rules of algebra do not admit. If any of your kind correspondents would explain this apparent anomaly, I have reason to believe you would be doing a service to others at the same time with, Yours, humbly,

R. B.

Eastern-road, Brighton, December 7, 1848.

THE BLAST FURNACE ACCIDENT (SEE ANTE P. 466.)

Sir,—Will you be kind enough to find room for the following replies to Mr. Radley's inquiries concerning the blast furnace accident.

The stop valve is seated in the side pipe of the hot-air apparatus, at the end where the blast leaves it, for the purpose f cutting off the cold blast when the apparatus is at work. When the stove is undergoing repairs the position of the valve is altered, which allows the furnace to be supplied with cold blast, and at the same time shuts off all blast from the stove. The waste is a "bye-flow" in the main pipes for the purpose stated. (For "front" in my former letter, read "fall.")

To each of the next three questions, *Yes.*

The hot-blast pipes had been in use about five months. The "cement" used is, for the most part *iron*, run into the joints, but a few of the joints are made with common cement, viz., boring dust and salamoniac. The flame was of a *blue* colour. A "breath of air" may pass into the furnace, when the blast is shut off. The stop valve is very nearly as described. AN OLD SUBSCRIBER.

Merthyr Tydvil, December, 9, 1848.

THE CROWN v. SMITH.

Court of Queen's Bench, (Before Mr. Justice Wightman and a Special Jury).

7th, 8th, 9th, 11th and 12th of Dec. 1848.

This was an action of *Scire Facias* brought in the name of THE CROWN to repeal certain Letters Patent granted to one Junius Smith on the 3rd of June, 1843, for the invention of "certain improvements in Machinery for Sawing Wood," being a "Communication from a foreigner residing abroad," (Mr. James Hamilton, of the United States.)

The specification of the patent states that these improvements "consist in the construction and equipments of saw-mill gates and frames, and saw-mill head blocks and holding dogs; such improvements being combined and connected in use, for the especial purpose of attaining mechanical means, by which timber may be sawed with a direct or indirect straight cut, or with a common or compound curved line, or in either case with the addition of a common straight or curved bevel, or compound of bevels, to the face or side of the timber, or what is technically termed a winding cut, for any required purpose, but more particularly for sawing timber into the various forms required for ship building."

After describing at great length the details of these improvements, the patentee says, "I DO NOT CLAIM ANY OF THE SEPARATE parts used in the construction of the whole machinery herein described, *all of such separate parts being well known, and in general use for various mechanical purposes.*"

"But what I do claim is as follows:—

"First: the mode of mounting the saw, c 8, *in an interior frame supported within the saw gate*, and *enabled to slide laterally* on the head-piece, *h*, and foot-piece, *k*, of the saw gate, *by the sockets, m m m m*, and *the guiding the saw with the forked guide lever*, c 3, for the purpose of enabling the attending workman to control and direct the lateral movement of the saw frame and saw, and at the same time direct the saw, e 8, at any required angle with the frame, in or by any required course or line formed on the log, when such mode of mounting and guiding are employed to effect either straight or curvilinear sawing of timber, including any merely mechanical variations that shall be substantially the same in construction, operation, and effect.

"Second: The application of the rotary shaft *a* 4; rotary holding dog, *a* 5; stop piece, *a* 6, and gauge bar, *a* 7, to form the means of giving a rotary motion through the leverage of the gauge bar, *a* 7, to a log of timber while supported by the dog, *a* 5, and the application of the index arm, *a* 8, quadrant frame, *a* 9, and *b* 1; screw shaft, *b* 2; pinion, *b* 3, and rack, *b* 4, to the purpose of controlling the motion of the gauge bar, *a* 7, and through that directing the rotary motion of the log while sawing; including the means of reversing this motion by the levers, *d* 4, and *b* 7, the pinions, *d* 5, and *d* 6; when such parts are so applied to saw timber with a simple bevel face to the cut, or with a face to the cut termed a winding face, or compound of bevels; *the whole of such parts being constructed, connected, applied, and operating to cut timber, as hereinbefore set forth*, including any merely mechanical variations that shall be substantially the same in construction, operation and effect."

Mr. COCKBURN, for the Crown, stated that the chief grounds on which the patent was sought to be repealed were, 1st, that the defendant was not in possession of the invention as set forth in the enrolled specification; for that, though there had been a specification enrolled, bearing to be signed and sealed by Smith, the deed was not in the same state when enrolled as when executed—there having been a sheet or two additional of matter interpolated subsequently by some person or persons without the privity or consent of Smith, and of which he was not, and could not have been, in possession at the time he put his hand and seal to the document. Second, that the invention was not new. And third, that it was of no public utility.

To establish the first ground of objection a great deal of documentary evidence was produced; but the document that would have served, beyond all others, to show how the matter really stood—namely, the specification itself, was not forthcoming. The defendant had been served with notice to produce it, *but declined doing so.** Neither did he choose to call the agent by whom the specification was prepared and enrolled (though in Court) who would have been able to rebut the charge of interpolation, if it had been untrue.

On the points of novelty and utility, the following witnesses were examined for the crown:—Mr. James Currie, C. E.; Mr.

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* The practice in England (but not in Scotland or Ireland) is to give back the original specification to the patentee or agent after it has been enrolled. Of the inconveniences which may result from this practice, the case before us is a striking proof; and we are glad to learn that there is a prospect of its being speedily abolished. ED. M. M.

Joseph Gibbs, C.E.; Mr. Alexander Gordon, C.E.; Mr. Murray, the chief engineer of the Portsmouth Dockyard; Mr. Jones, superintendent of a large sawing establishment at Bridgewater; Mr. Jordan, the inventor of the celebrated carving machinery; Professor Woodcroft, of the London University College; Mr. Vaughan, of the Deptford Dockyard; and Mr. Mackintosh, of the Woolwich Yard.

The evidence of these gentlemen was to the following effect:—The mode claimed by the defendant of "mounting the saw in an interior frame, supported within a saw-gate," and enabled to slide laterally on the head piece, was not new, because precisely the same method had been adopted by Gibbs and Gattley, in a sawing machine patented by them in 1833. Neither was "the guiding the saw with the forked guide-lever" new; for Mr. Jones had employed the same contrivance more than fifteen years ago in a machine for sawing chair backs,—the only difference being, that he gave the requisite direction to the tool by means of a slotted bar or templet, while the defendant does this by hand. Besides, supposing the defendant's forked lever to be applied as he proposes, at the middle of the saw, immediately above the wood, and supposing also the saw to be in that state of extreme tension which is required for rapid sawing by steam power (stated by Mr. Murray to be equal to a strain of two tons), it could not actuate the whole saw from top to bottom equally, but would have a tendency to warp it, and cause it thereoy not only to produce bad work, but to lose, from excessive friction, its required temper. The mode of holding the timber to be sawn between dogs, was also old—so old that there had never been any machine sawing without it. *Rotating* dogs, such as the defendant employs, and his contrivances for causing them to rotate and carry the wood round with them, so as to produce bevels of any required angle, or series of angles, had not, to the knowledge of any of the witnesses, been employed before; but the same thing in substance and effect had been repeatedly done long before—first, by means of an oscillating table, as recommended by the late Sir Samuel Bentham, described in his patent of 23rd April, 1793*—afterwards by means of a modification of that Table, patented by Hamilton himself (the real defendant in this case), in 1833—and still earlier by screws and pinions, as in a machine used at Deptford Dockyard for upwards of twenty years past for shaping staves, and by which curves and bevels of all sorts, and (by a corresponding enlargement of the machine)

* Sir Samuel Bentham was the first to introduce saw-mills into our naval arsenals; the first also to lay down the principles on which all sorts of machine sawing may be constructed, and which have never since been materially departed from. The specification of his patent, 23rd April, 1793, is a perfect treatise on the subject—indeed, the only one worth quoting which has, to this day, been written on the subject. It will be found at length in the volume of the *Repertory of Arts* for 1799. In another work of General Bentham's (*Statement of Services*), he gives a historical notice of the circumstances attending the introduction of machine sawing into England, which has a close enough relation to the subject matter of the present trial to make no apology necessary for inserting it in this place:—

"Fully established as the use of steam engines is seen to be at present in his Majesty's naval arsenals, and great as are the advantages which are now seen to be the result, the value of the service rendered in effecting this improvement, is not likely at this time to be duly appreciated, unless the state of things previously to, and during the introduction of this improvement, be taken into account, and borne in mind. When (with leave of absence from the Russian service) in the year 1791, I made a tour in this country, visiting the principal manufactories, I found, it is true, steam engines extensively employed for giving motion to pumps for raising water from mines, to machinery for working cotton, and to mills for rolling, and for some other works in metal: but in regard to the working in wood, steam engines had not been applied to this purpose, as no machinery or engines, other than turning lathes, had, so far as I learnt, as yet been introduced for the working of this material, excepting that some circular and reciprocating saws, and boring tools, had been applied to the purpose of block-making, by the contractors who supplied blocks to the navy; even saw-mills for slitting timber, though in very extensive use abroad, were not to be found in this country. An attempt indeed had been made to introduce a saw mill in the neighbourhood of London, but the destruction of it by the machinations of sawyers, seemed to have prevented any farther attempts at innovations of this nature. For my part, I had, whilst in Russia, made some progress in contriving such machinery for shaping wood as should insure accuracy and save manual labour: which contrivance, soon after my return to this country, I had occasion to carry to a much greater extent, with a view to the affording beneficial employment to some thousands of untaught hands, in a public establishment; with this view, I analyzed the several operations requisite for working in various materials, more particularly in wood; and finding the artificial, but common classification of works according to the trades or handicrafts for which they are used, was productive of a variety of inconveniences, and even mischiefs, I classed the several operations that have place in the working materials of every description, according to the nature of the operations themselves; and in regard to wood particularly, I contrived machines or engines for performing most of those operations whereby the need of skill and dexterity in the workman was done away. These machines, or engines, being capable of being brought into action by the simple process of turning an axis, were consequently capable of being worked by a steam engine, or any other inanimate force. In regard to the application of *this machinery for working in wood, besides the general operations of planing, rebating, morticing, sawing in curved, winding, and transverse directions*, I had completed

of any dimensions, are or can be readily produced. (*Mr. Vaughan*, who spoke to this fact, produced a number of most indisputable specimens.) The same precise combination of parts as specified and claimed by the defendant might not have been before used, but precisely the same things which he professed to accomplish by it, had been before accomplished. He had not carried the art of machine sawing one step beyond the point it had previously reached. Neither was his machine, as described in the specification, one which could be worked with economy, if worked at all. For, besides the risk of warping, heating, and destroying the saws, and spoiling the work, before adverted to, there were other serious objections to the machine. The log must be kept perfectly steady while in the course of being cut, in order to ensure exact curve and bevel lines; but there were no sufficient means for this purpose set forth in the specification. The mere holding of the wood between *end* dogs, was wholly insufficient. The defendant suggests in his specification that a bar, weighted at one end (like a steel-yard), may be inserted beneath the middle of the wood; but this could only tend to increase the vibratory motion produced on the log by the up-and-down movements of the saw—to do harm, in fact, more than good. Perfectly straight pieces might possibly be cut with no other holding than the end dogs; but not crooked and unshapely pieces, with a large bend or bight, in which it is always a matter of great difficulty to make the exact line between the two dogs correspond with the centre of gravity of the log of timber, and a very small shaking is sufficient to make the log cant over. Again, the defendant's machine requires to be stopped for two or three minutes every time the bevil is changed; and in such pieces of wood as ships' futtocks, such changes occur as often as from six to twelve times in lengths of 12 and 15 feet—so that there must be a loss of time from this cause, which would detract

in the way of example, an apparatus for preparing all the parts of a highly-finished window-sash; another for every part of the more complicated article, an ornamented carriage-wheel; so as that no dexterity or skill remaining necessary in the cutting out, shaping, or smoothing the several parts completely, the whole of those operations were capable of being performed as well by a steam engine as by manual labour; and nothing remained for finishing the work of the joiner or wheelwright, but the putting the several component parts together. In the year 1794, it having become a good deal known, that I had at my brother's residence,* in Queen Square-place, these and other machines in a working state, several members of his Majesty's then Administration, having been pleased to express a wish to see them, honoured me with repeated visits; and were in consequence, so well satisfied of the national advantages that would be derived from the use of the system of machinery then shown to them, that it became a subject of public notice in the House of Commons; where the late Lord Viscount Melville, in particular, bestowed great encomiums on it. Having thus brought a system of machinery to a state of considerable perfection, and many parts of it being applicable to the execution of works, which at the time were performed by hand in the several dockyards; I accordingly communicated upon the subject with the naval part of His Majesty's administration, who were so fully convinced of the justness of the representations I made to them, of the advantages that could not fail to result from the introduction into His Majesty's Naval Arsenals of such engines, as well as from the use of steam-engines, as a *primum mobile*, that the authority of the then Lords Commissioners of the Admiralty was given me early in the year 1795, to visit His Majesty's dockyards for the express purpose, amongst others, of suggesting in what cases, in my opinion, my system of machinery might with advantage be introduced. The authority which was given to me, and the prospects that naturally flowed from it, led to the relinquishing my intentions, both of returning to Russia, and of deriving profit from the machinery in private undertakings. From thenceforward I devoted myself entirely to His Majesty's service, and directed my attention exclusively to the mode of accomplishing the several objects I had presented to their Lordships' notice.

Sir Samuel Bentham must be considered as having made for his own sake an unfortunate choice. No person connected with the naval science of England in its civil departments, has conferred more important benefits upon it, and no one has been so shamefully ill rewarded.

The particular plan of turning the log referred to by the witnesses for the Crown is thus described in General Bentham's specification:

"*How to cut to bevellings and to windings.* The angles which two contiguous furnaces of a piece form together at their meeting, and which is not a right angle, is called by some workmen the bevelling. The cutting a piece then to any bevelling remaining the same, may be easily effected, by the position in which the piece is confined on the sliding-bed, and that in longitudinal sawing as well as cross cutting: but, if the bevelling is required to vary in the course of the cut, so as to produce a winding surface, forming certain given bevellings, and those different ones at different positions of its length, for this purpose, the following apparatus may be employed. Let the frame or bench on which the sliding-bed moves, when there is a sliding-bed, and on which the piece itself moves, when there is no sliding-bed, be made to tilt or turn on a pin or gudgeon at each end, so placed as that, if joined, they would form an axis, passing lengthways through the middle of the bench, at the height of the upper surface of whatever is used to support the piece, and through the saw. On one side of this axis let the bench be loaded, in such a manner that, if it had no support, it would drop on that side, till it assumed nearly a vertical instead of a horizontal position. From the under part of this side, project a leg or support downwards, towards the floor; then let a wedge, or waved mould, which may be called a *director*, the motion of which is connected with that of the piece to be sawn, be made to slide on the floor under this leg; and let the thickness or height of this director, at different parts of its length, be adapted to raise the leg of the bench more or less, according to the angle the bench should make with the saw, itself moving all the while invariably up and down, in a perpendicular direction."

* The celebrated Jeremy Bentham.

largely from the economical value of the machine. None of the witnesses had seen anything more than a model of the defendant's machine produced in Court (the accuracy of which, however, was sworn to and admitted); for though the defendant was said to have built a machine on a large scale at Stepney, and had shown it at work to his own witnesses, he had refused, when applied to, to give the necessary facilities for an inspection of that machine on the part of the Crown.

"So far (as the judge observed in his summing up), all was mere theory" with respect to the actual working of the machine. The witnesses *thought* it would not work, that was all. They did not say that they had actually seen it in operation on a working scale, and that they had seen it fail. However, there was one other witness produced for the prevention, whose evidence was wholly free from that objection. This was a M. Capus, the engineer superintendent of the sawing machinery at the dockyard of Toulon. He stated that Mr. Hamilton, who had taken out a patent for his invention in France, had obtained the leave of the French authorities to put up a machine on trial in the dockyard at Toulon; that a machine which was made at Paris under Mr. Hamilton's own superintendence, and resembled in all respects the model exhibited in court (and sworn to as being made in perfect conformity with the specification) was brought by him to Toulon and tried there, under the direction of Mr. Hamilton, and in the presence of a Government Commission—that the trial proved an utter failure; that they set it to cut futtocks, and it would not—futtocks, too, of very easy curves; that it was perfectly *blind* (could not follow the lines chalked out for it); that the Government Commission pronounced it to be in its then state wholly useless—"incapable of anything like mathematical accuracy;" that Mr. Hamilton assented to the inefficiency of the machine, but said he could improve it so as to make it do all that was desired—that two or three months afterwards it was reproduced in an improved shape—the principal alterations being the application of three] guide levers (instead of one) to the saw, one being applied at top, one at the middle, and one at bottom (a sort of parallel motion), and the placing of a support under the centre of the log in the course of sawing (to obviate the very objections taken to the specified machine by the witnesses for the Crown), and that *then* it worked most satisfactorily.

Sir Frederick Thesiger, for the defendant, undertook to show by witnesses of most unimpeachable character, that a machine, on a working scale, constructed according to the specification, had actually done in their presence all those things which the witnesses for the Crown *supposed* it to be incapable of doing, and had done them better than any other previously known machine. Once on a time (as the story went) there had been a caviller who denied that man had the power of voluntary motion; all the answer vouchsafed by a sage who was present on the occasion, was—*to get up and walk*. And so in this case—he would content himself by opposing facts to fancies, and leave the jury to decide which was the most deserving of credit.

The leading witnesses in support of this line of defence were Mr. Carpmael and Mr. Cottam. They believed the invention of the defendant to be new in the general combination of parts of which it consisted, and exceedingly useful. They had seen logs cut, not only to as large a curve as was usually required in ship timber, but with varying bevels, by a machine put up at Stepney, which was constructed exactly according to the specification, and corresponded with the model now produced in Court. It did its work beautifully—admirably. There was no support required beyond that afforded by the end-dogs—no perceptible vibration whatever. You might sit on the log while it was in the course of being sawed without feeling the action (Carpmael). The saw was worked at the proper tension, and did not warp or heat in the least. You could put your hand to it without being at all inconvenienced. The machine has to be stopped for a minute or so at each change of the bevel, but that was all. Both bevel and curve could be changed to any extent, and as often as might be desired. The advantages of the machine over hand labour, in point both of dispatch and economy, were great and incontestable.

Mr. Carpmael cross-examined.—Are you not a witness, on one side or other, in nearly every patent case that comes before the courts?—I am.

Mr. Cottam cross-examined.—Are you not also in the practice of giving your evidence in patent cases, and generally on the same side with Mr. Carpmael?—Yes, but not always on the same side with Mr. Carpmael.

Professor Cowper, of King's College, stated that he had also seen the machine at Stepney, and concurred generally in the opinions of Messrs. Carpmael and Cottam.

Mr. Wigram (the eminent ship-builder), examined.—Had sent a number of pieces of timber to the defendant's premises at Stepney, for the purpose of testing the capabilities of his machine. They were of all sorts

straight and crooked, and he was allowed to choose for himself the curves and the bevels at which they should be cut. They included some of the most difficult shapes required in ship-building. Was himself present during the greater part of the experiments, as also one of his foremen. The machine was, to the best of his recollection and judgment, exactly similar to the model exhibited in Court, with the exception that the log was not turned by a gauge-bar, but by an index-rod and quadrant (both methods are described and claimed in the specification.) The machine did the work to his perfect satisfaction. Each piece was cut of the exact curve and bevels required, by one *continuous operation from end to end, and without any intermission whatever.* In one case, there were as many as six changes of bevel in a length of about 12 or 14 feet. Had never known or heard of any machine before the date of the defendant's patent which could effect what it did, and had not a doubt of its proving of great advantage in ship-building, and thought the invention altogether one of great merit and utility.

Mr. Green (not *the* Mr. Green of the house of Messrs. Wigram and Green, but a working engineer of the same name), stated that he was the person who had worked the defendant's machine in all the experiments spoken to by the other witnesses. The model produced was an exact copy of that machine, and both were made precisely according to the specification of the defendant. No support to the middle of the log was necessary—neither in the case of straight nor of crooked timber; and none was used in the experiments. Anything that the machine could do, the model could do, allowing for the difference in the dimensions. He illustrated this by sawing a piece of timber with the model in the presence of the Court and jury. The curve cut by the saw was considerable, but the piece itself was straight, or nearly so. It was cut also with a winding bevel, but with short pauses between the changes.

Cross-examined by Mr. Cockburn.—You say the model will do crooked as well as straight timber. Will it do this? (holding up to witness a piece much more crooked than the other, but not more so than is usual with ships' futtocks.) Oh, yes; much more crooked than that.

Then do it. (Witness—after some hesitation).—It won't come within the range of the model.

Oh, yes it will. We took the exact measure of your model, and this piece has been made to fit it. You can try it. (Witness tried, and found this to be the case, but still hesitating—)

Mr. Cockburn to the Court.—My Lord, I challenge the witness to do by the machine what he assured us a minute or two ago it would do. And I am instructed to rest the whole case upon the result.

Witness.—It cannot be done without a support. (Great sensation in Court.)

Oh, without a support! But you told us you knew that no support was necessary, whether the wood was crooked or not; and so, indeed, all the other witnesses for the defendant have sworn. Will you now tell us, on your oath, whether any support was used in the experiments made before Mr. Wigram? *Yes; but only for a little time.*

What was it like? (Witness drew and exhibited a sketch of an apparatus, having the appearance of a roller supported on standards.)

Was it attached to the machine? No.

It might be applied to it as wanted, and taken away again? Yes.

Is it there now? Yes.

[It may be here proper to state, that it appeared in the course of the trial—not from any formal proof, however, adduced on the subject, but from sundry hints and allusions which dropped from the counsel and witnesses—that there are two rival sawing-machines in the field; one by Mr. Hamilton, the patent for which it was the object of this action to repeal; and one by a Mr. Cochrane, which has been in public use for some time past at the Dockyard, Woolwich; — that Hamilton brought an action for infringement against Cochrane, which was tried at Guildford, in August last, when a verdict was found for the plaintiff*—that one of the principal features of distinction between the two machines then insisted upon by Cochrane, was, that his machine had a roller support, of the description represented by Green, by means of which he could accomplish what Hamilton's could not do without it—and that Hamilton did then, as now (till the last moment), deny that any such support was necessary.]

Mr. Soane, the foreman of Mr. Wigram, who was present at the experiments witnessed by that gentleman, being next called, fully confirmed the fact of the roller-support having been used on that occasion.

Mr. Cockburn replied on the whole case in a speech of remarkable ability and eloquence. He held the fact of the interpolation in the specification to be as clear as the sun at noon day. Mr. Hamilton had the means at his command of exonerating him-

* A rule *nisi* for a new trial was obtained last term, and now stands over for argument.

self, if it were possible, from the charge of having dealt (by his agents) fradulently with the document, and not having done so, the inference was unavoidable that the case was as alleged for the Crown. He (Smith) had not enrolled as required by the letters patent a specification "under *his* hand and seal." The specification enrolled was not *his* specification, but a specification by some one else, of which he knew nothing, or to which, at all events, he was no party.

The evidence as to the novelty and ability of the invention was, for the greater part, very conflicting—a number of witnesses on the one side pronouncing that to be impracticable which witnesses on the other side declared they had actually seen done, but the jury were to take into consideration the characters of the two sets of witnesses. For the Crown the witnesses were all of that class precisely who were most likely to assist the jury to come to a right conclusion on the case—persons who had been, or were themselves, practically engaged in sawing machinery and ship-building, or who had devoted special attention to these subjects—engineers from the dockyards, superintendents of private sawing and engineering establishments doing a large business—inventors who had themselves contrived and introduced into practice some of the very things which the defendant now desired to turn to his own exclusive account — all persons, too, not one of whom had any personal interest in the issue. For the defendant, on the other hand, the two leading witnesses were gentlemen of whom he was entitled to say tnis at least, that they were "mercenary witnesses," because confessedly they made a "traffic in testimony" in patent cases, hunted in couple and joined tongue together; and a third was the person named Green, who had given the extraordinary testimony with which the case for the defendant closed, and which could only be accounted for by the great personal interest which he obviously had in the success of his employer. Mr. Wigram was a witness of a very different stamp from these. He was a gentleman of such high standing and character—so unquestionable an authority in all matters relating to ship-building—that he had at once said to his learned colleagues on hearing his testimony, "If we cannot get over this, our case is at an end." It was impossible to entertain for one moment the idea, that Mr. Wigram had said one word more than he honestly and conscientiously believed to be the truth. But Mr. Wigram had clearly been deceived. From the facts fortunately elicited at the last moment from the witnesses, Green and Soane, it was established beyond all question that Mr. Wirgam had been led to believe that the machine which he saw at work was a machine constructed and worked precisely according to the defendant's specification, when it was no such thing. A gross deception had been practised on Mr. Wigram, and through him attempted to be practised on the Jury, the Court, and the country. Much had been said about the speculative character of the testimony of the witnesses for the Crown—none of them had seen the defendant's machine at work. Supposing that to be true, it was the defendant's fault that they had not done so—an inspection by the Crown witnesses had been applied for, but refused; or, at least, only conceded at so late a period as to make the concession of no use. Neither was the remark true of all the Crown witnesses—it applied only to the English witnesses, and not at all to M. Capus, of the Dockyard, Toulon. He had seen a machine worked there which had been constructed under Mr. Hamilton's own superintendence, and exactly according to his specification; he had seen it tried, too, in the presence of a commission of Government officers, and of Mr. Hamilton himself; and he had seen it fail utterly. Two or three months afterwards, this same M. Capus saw the machine in an improved state—when there had been added to it precisely those things which the English witnesses for the Crown had said it wanted to make it a good working machine—namely, the threefold guide lever, or parallel, motion, and the roller support; and then, and not till then, it did work well. Piracy, forsooth! Mr. Cochrane had been charged with pirating the invention of Mr. Hamilton. He would retort the charge. Mr. Hamilton was the only real pirate in this case. He had first put a number of things together, every one of which he admitted to be old, and claimed a monopoly of his combination, as producing a new and useful result; and to which combination, if the fact were so, he was by law entitled. But his combination had turned out to be useless; and then he takes and adds to it sundry contrivances which were not invented by him nor mentioned in his specification—contrivances borrowed from the machine of a rival patentee, Mr. Cochrane; and by those additions, makes that machine useful which was before of no use whatever—studiously concealing all the while, however, that any such additions had been made—pretending that his machine was now as it ever had been, and thereby inducing respectable people to certify, that to be true of his machine in its original and patented state, which was only true of it when altogether altered. The case was, from beginning to end, one of gross fraud, deception, and trickery; and the learned Counsel left

it in the hands of the Jury with the fullest confidence that they would find a verdict for the Crown.

The learned Judge summed up the case at great length, and remitted it to the Jury, with a series of questions, according to their answers to which the verdict would be framed. The following are the questions, with the findings of the Jury annexed to them:

1. Is the mode of mounting the saw in an interior frame supported within the saw gate, and enabled to slide laterally, new? .... No.
2. Is the guiding the same with a forked guide-lever new? ..... No.
3. Is the combination of No. 1 and 2 new? .... Yes.
4. If No. 3 is new, is it useful?.. No.
5. Is the mode of mounting the log new? .... No.
6. Is the mode of turning it new? Yes.
7. Is the combination of No. 5 and 6 new? .... Yes.
8. If so, is that combination useful? .... No.
9. If a machine were made in strict conformity with the specification, would it produce the effects stated therein?.... No.
10. Was Smith in the possession of the invention by means of a communication from a foreigner? .... Yes.
11. Was he in possession of it at the date of his applying for the patent, or at the date of the patent, or at the date of the specification? .... No.

In effect, this is a VERDICT FOR THE CROWN. What is useful, the Jury found not to be new, and what is new, not to be useful.

Counsel for the Prosecution—Mr. Cockburn, Q. C.; Mr. Chambers, Q. C.; Mr. Hindmarch; Mr. Webster. Solicitors—Messrs. Hill and Heald.

Counsel for the Defendants—Sir Frederick Thesiger; Sergeant Channel; Sergeant Shee; Mr. Peacock. Solicitors—Messrs. Oliverson and Co.

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* This report has been drawn up chiefly from memory, and has, therefore, no pretensions to literal accuracy; but we believe it will be found, on the whole, substantially correct.—Ed. M. M.

ENGLISH SPECIFICATIONS ENROLLED DURING THE WEEK ENDING DEC. 16.

Charles Henry Capper, Edgbaston, Warwick, Gentleman. *For a method of preparing and cleaning minerals and other substances.* Patent dated June 13, 1848; specification enrolled June 11, 1848.

This invention relates to four different apparatuses for sieving and cleaning ores.

The first apparatus for sizing or sieving the ore, consists of a water vessel, over which is suspended a wire-gauze cylinder, in a slanting direction. The meshes of the upper half of the sieve are smaller than those of the under half. The axle of the highest end of the cylinder is furnished with a pulley, by which rotary motion is imparted to it, through the intervention of an endless band, from any prime mover. A vertical partition, placed exactly underneath where the two-sized gauzes meet in the centre of the cylinder, divides the water vessel into two parts. The ore, after it has been reduced into small pieces, is introduced into the upper half of the cylinder, the gauze of which contains the smallest sized meshes. On rotary motion being communicated to the cylinder, such particles of ore as are smaller than the meshes fall through into the water contained in the first half of the water vessel. The rest of the ore then rolls down into the second half of the cylinder; and such pieces of ore as are small enough, fall through the meshes into the second half of the water vessel, while the ore which may yet remain in the cylinder, is, by its rotary motion, projected into a shoot which conveys it into a suitable receptacle.

The apparatus used in connection with the preceding, for dressing the sifted ore, consists of a vessel with a wire-gauze bottom, perforated with holes, into which the ore is conveyed from a hopper furnished with a suitable arrangement for regulating its supply. This vessel is fitted (one on each side) with two tubes or shoots, which slant downward; and is placed inside a water vessel, through the sides of which these shoots pass out into another water vessel. On a jigging motion being communicated by means of a lever to the inside apparatus, such particles as are small enough will pass through the bottom of it into the first water vessel, while the larger pieces will be conveyed by the slanting tubes or shoots into the second or outside water vessel.

A *second* cleansing apparatus consists of a semicircular horizontal trough, suspended eccentrically over and partially immersed in a vessel containing water. The trough is fitted at one end with a rod, carrying a bob to balance the ore contained in it, while a

vibratory or oscillating motion is communicated to it at the other end, whereby the water, flowing in and out over the top, carries with it the earthy particles in suspension, while the ore remains undisturbed at the bottom of the trough.

A *third* apparatus consists of a wheel rotating slowly in a vertical plane, and furnished on each side of the periphery with a flange. The ore is conveyed through a shoot from a hopper on or near to the highest point of the wheel, between the flanges, where it encounters a stream of water flowing in a contrary direction from a cistern above. This stream of water, meeting with the ore, holds in suspension the earthy particles combined with it, and carries them round the wheel in a direction the opposite to its rotation, and delivers them through a shoot into a suitable receptacle. The ore, remaining undisturbed by the current of the water, is carried round with the wheel, and is delivered through a shoot.

The whole of these apparatuses are stated to be applicable to the cleaning of substances the component parts of which are of different densities.

Claims.—The patentee, passing over the first, or sieving apparatus, claims—

1. The construction of a jigging apparatus, with a perforated bottom, through which the small pieces of ore pass, and the application of tubes or shoots to convey away the other particles, as described.

2. The construction of an apparatus in which the ore to be dressed is placed in a trough partially immersed, to which oscillating motion is communicated, whereby the earthy particles are held in solution, and separated from the ore, as described.

3. The construction of apparatus in which the ore to be dressed is brought on or near to the highest point, of a wheel revolving in a vertical plane where it is subjected to the action of a current of water conducted to near the same point, and flowing in a contrary direction.

THOMAS DALTON, silk dyer. *For improvements in the manufacture of fringes, gimps, and bullions.* Patent dated June 8, 1848; specification enrolled December 8, 1848.

The patentee states that fringes are woven two at a time, that is with sufficient of the material of which the fringes to be formed left between the double selvaged strips of stuff and afterwards slit up longitudinally, and that his invention consists, *First*, in printing by the ordinary means the fringe parts after they are woven and before they are slit up, whereby their stretching upon a printing table is facilitated. *Second*, when the two fringes have to be printed with different patterns, in weaving an intermediate piece between the two fringes, which is divided longitudinally so as to allow of each fringe being stretched for printing. *Third*, in printing in the same manner gimp silk twist after it has been woven; and *fourth*, in the manufacture, by the ordinary means, of fringes and bullions with printed weft.

Claims.—

1. The manufacture of fringes of silk twist or sewings, and of linen sewings, by printing them after they are woven, and also printing gimps composed of silk twist.

2. The application of printed weft to the manufacture of fringes and bullions.

JOSEPH FOOT, Spital-square, Middlesex, silk manufacturer. *For improvements in making skeins of silk.* (A communication.) Patent dated June 8, 1848; specification enrolled December 8, 1848.

The patentee remarks that when silk manufacturers give out skeins to be dyed, a considerable quantity is frequently abstracted by the workmen without their being able to prove the fact, or to ascertain how much, in consequence of the silk changing weight by the operation. To prevent this, they have been accustomed to pass the ends of the skeins through cards, and knot them, but as the workman can easily untie these knots this precaution is of little use. Now, this invention has for its object to render the abstraction of silk from a skein, without detection, impossible; and consists in connecting the ends of the cord employed to tie up the skeins and weaving them into a piece of stuff by a machine which differs but slightly from a common ribbon weaving machine.

Claim.—The connecting the ends of the cords employed in fastening or binding the skeins of silk and forming a woven fabric upon them.

ALEXANDRE PAUL MARIE DARLU, Paris, gentleman. *For improvements in obtaining motive power.* Patent dated June 8, 1848; specification enrolled December 8, 1848.

Monsieur Alexandre Paul Marie Darlu is in a sad case. Either he has invented sundry things not worth specifying, or he has fallen into the hands of some malicious wag of a translator, who has made it his study to make "Monsieur" deliver himself in his specification of as much unintelligible gibberish aa possible. Our courts have held that a specification may be good enough in law, though in the worst possible English, as long as the patentee's real meaning is made sufficiently clear by it; but none of the authorities go so far as to say, that any amount of foreign nonsense can be changed into the most infinitesimal amount of sterling

sense by simply converting it into broken English. If, therefore, there be anything really good at the bottom of this Parisian gentleman's patent, the translator has been guilty of something beyond a joke, in not making this manifest to the world at large He might have been contented with raising a laugh at the expense of "Monsieur's" imperfect knowledge of the English language; and should, in common charity, have prevented him from placing on record a specification which, as it stands, is so incomprehensible as to render the patent good for nothing. The specification is of great length (six skins) and we have gone through the whole of it with the utmost care, but all to no purpose. We can make literally nothing of it—"neither flesh, nor fish, nor good red herring." All we can do, under the circumstances, is to place the "claims" of "Monsieur" before our readers *in totidem verbis*—a sort of *pas de deux* exhibition, in which patentee and translator will be seen to exhibit themselves to equal advantage.

Claims.—

1. "The application of *light - valved* chambers *to gaseous agents* without the addition of pumps and piston, and *in my above specified valve.*

2. "The application of *these simple apparatuses* to hydraulics *either by aspiration or insufflation.*

3. "The utilising of the wasted steam of fire engines to augment the power or lessen the expense by means of *light-valved* chambers, with or without the injection of water.

4. "The application of compressed air *by insufflation* to the direct propulsion of vessels.

5. "The apparatus specified under the denomination of *pneumatic remonteur* agent *totally exempt of all complications.*"

Sir Henry Hart, Commissioner of Greenwich Hospital, Rear-Admiral, R.N. *For improvements in apparatus for preventing what are called smoky chimneys.* Patent dated June 13, 1848; specification enrolled December 13, 1848.

This invention consists in the employment of wheels made to rotate by the currents of the atmosphere, so as to withdraw the air from chimneys and flues, and brought into position by means of an arrow or vane.

The patentee represents three several mode of applying his invention. One consists in placing a fan wheel partially within the revolving part of the top of the chimney; so that a current of air may act upon the fans which project above it, and thereby create a draft. Another in cutting away a portion of the top part of the chimney, and placing the fan-wheel therein, taking care, however, to leave a portion of the fans exposed to the action of the air. A third, in placing the fan-wheel within the side of the chimney fronting the wind, and covering the top fans with a shield, so that the air may act upon the bottom ones, and drive the smoke up the chimney.

Claim.—The employment of wheels made to rotate by the air so as to withdraw the air from the chimey or flue, and brought in to position by means of an arrow or vane.

Joshua Procter Westhead, Manchester. *For manufacturing fur into fabrics.* (A communication.) Patent dated June 8, 1848; specification enrolled Dec. 13, 1848.

This patent was granted on the 8th of June last, and the specification should consequently have been enrolled on or before the 8th of December. It was not enrolled, however, until the 13th; so that Mr. Westhead's patent has become null and void for want of specification within the period allowed by law. In the vain hope of averting this forfeiture, Mr. Westhead recites that his patent was granted on the 13th instead of the 8th; but the fact is as we have stated.

This lost invention—lost so far as the patentee is concerned—consists in preparing the fine, short, soft hair of animals in the same way as is practised in the manufacture of hats, and in subsequently carding it, making it into rovings or slubbings, which are spun into yarn, and woven into fabrics in the same way as wool, &c.

Claim 1.—The causing fur to be prepared, carded, made into rovings or slubbings, spun into yarn, and woven into fabrics.

2. The employment of fur which has been subjected to the process of carroting in the manufacture of yarn.

William Chamberlain, jun., St. Leonards on the Sea, Sussex. *For improvements in apparatus for recording votes at elections.* Patent dated June 13, 1848; specification enrolled December 13, 1848.

The subject of this invention is a novel specimen of ballot-box, which consists of a quadrangular case, containing as many horizontal sliding bars as there are candidates. Each bar is furnished with a catch, which acts upon a corresponding ratchet-wheel: so that when the bar is pulled out, the wheel is moved one tooth on, and which, in combination with any ordinary counting or recording apparatus, records a vote for the candidate to whom that bar is appropriated. There is also another ratchet-wheel common to all the sliding bars, by which the total number of votes given for all the candidates may be indicated upon a

dial, open to public inspection. The patentee then describes certain mechanical arrangements in combination with the door of the apartment in which the balloting machine is contained; so that the voter may be prevented from giving more than one vote to a candidate, and from voting for more than one candidate. Only one voter is admitted at a time into the room, which Mr. Chamberlain remarks should be lighted sufficiently to enable the voter to distinguish the knobs of the slide-bars of the rival candidates, but not so much so as to enable any curious individual to ascertain which bar the voter has handled.

Claims.—The patentee states that he does not confine himself to the precise details, as they may be varied, so long as the peculiar character of the invention is retained, which consists of mechanical arrangements, in combination with ordinary counting or recording apparatuses, whereby an elector may give his vote without its being known to whom, and at the same time prevented from voting for more than one candidate, and giving more than one vote.

WILLIAM HUNT, Dodderhill, Worcester, Chemist. *For improved apparatus to be used in processes connected with the manufacture of certain metals and salts.* Patent dated June 13, 1848; specification enrolled December 13, 1848.

This invention consists in a peculiar construction of reverberatory furnaces, whether employed in puddling iron, or in the manufacture of iron, copper, zinc, &c., or the salts of soda, &c., by which the manufacturer is enabled to employ coal of less price than hitherto.

The furnace is constructed like the ordinary reverberatory furnace, with this difference only—that there is between the bars of the grate and the end of the furnace a bed or floor, suitably supported a little above the level of the grate. In the end of the furnace are two apertures, in which are the rakes, with the inside extremities of sufficient size as to nearly close these apertures when pulled out to their full extent. And above them, are a number of holes for the admission of air, over which slides a horizontal damper, pierced with holes to correspond; and by means of which the admission of air to the furnace is regulated. In the side of the furnace, above the bed, is a door for the introduction of the coal, and over the grate is another door, to admit of access to it to remove the clinkers, &c.

Supposing the grate to be covered with live coal, small coal is introduced upon the bed, which in a short time becomes, by the radiation of heat, partially carbonized and porous; it is then pushed down by the rakes upon the grate, and a fresh supply introduced.

Claims.—The peculiar construction of reverberatory furnaces employed in the manufacture of metals or salts, which provides for the coal to be used being exposed to heat upon a bed or floor, previously to its transmission to the grate; and also the regulated admission of air necessary to the combustion of the gaseous products evolved.

JOHN MILLER, Henrietta-street, Covent-garden, gentleman. *For a new system of accelerated menattrite locomotion, even by animal expulsion, for every species of transport machines acting by means of wheels, whether on land or water.* (A communication.) Patent dated June 13, 1848; specification enrolled December 13, 1848.

A patent with an incomprehensible title and equally incomprehensible specification. The objects sought to be attained seem to be the reducing of friction, and the obtaining accelerated motion. The specification occupies eighteen skins of parchment, and ten sheets of drawings, covered with figures of the most fantastic kind of vehicles, &c., imaginable.

The patentee claims the application to "menattrite locomotion generally, severally, and particularly," of the following apparatuses, as described:—

Elastic bearing-wheels.
Normal vogue paddles.
Free axle-wheels.
Apparatus of gravitation.
Apparatus of transmission.
Apparatus of collocation.
Porte monte (mover bearer.)
Cutter.
Cross brakes.
Pilot.
Steam propeller and normal vogue paddles.

What he means by the word "menattrite" he nowhere explains.

JOSHUA TAYLOR BEALE, East Greenwich, C.E. *For improvements in the construction and arrangement of engines and machinery for propelling boats or vessels on water, with a means of preventing incrustation in the boilers, parts of which improvements are applicable to land purposes.* Patent dated June 13, 1848; specification enrolled December 13, 1848.

These improvements refer, 1stly. To improved rotary engines and pumps. 2ndly. To a new combination of reciprocating steam-engine cylinders, and the application of improved rotary pumps to reciprocating engines, and also to an improved construction of frame for carrying the cylinders of steam-engines. 3rdly. To a new propeller and thrust apparatus. And 4thly. To the prevention of incrustation in steam boilers.

But there is no claim—no statement, therefore, of what is old and what is new, as required by law.

RICHARD WANT and GEORGE VERNUM, Enfield, Middlesex, engineers. *For an improved steam engine, which may be also worked by air and other fluids.* Patent dated June 10, 1848; specification enrolled December 9, 1848.

(*See ante p.* 577.)

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Dec. 12	1697	James Tod and Son ...	Edinburgh, engineers	Railway carriage cork buffer.
,,	1698	John Rogers	Kennington	Draft accelerator.
13	1699	T. H. Thompson, C.E.,	Strand	Blind roller.
,,	1700	James Wallis Dann....	Cromer-street, Gray's Inn-road..	Ball valve.

WEEKLY LIST OF NEW ENGLISH PATENTS.

James Young, of Manchester, manufacturing chemist, for improvements in the preparation of certain materials used in dyeing and printing. December 9; six months.

John Gardner, of Wokingham, engineer, for improvements in girders for bridges and other structures. December 9; six months.

William Ironside Tait, of Rugby, Warwickshire, printer and bookseller, for an improved method or methods of producing outlines on paper, pasteboard, parchment, papier mache, and other like fabrics. December 9; six months.

Andrew Lamb, of Southampton, engineer, and William Alltoft Summers, of Millbrook, Southampton, engineer, for certain improvements in steam engines and steam boilers, and in certain apparatus connected therewith. December 9; six months.

John Tutton, of 20, South Audley-street, Grosvenor-square, mechanist, for certain improvements in the construction and arrangement of certain parts of buildings. December 9; six months.

Christopher Nickels, of the Albany-road, Camberwell, gentleman, for improvements in the manufacture of gloves and articles of dress and furniture. December 9; six months.

William Palmer, of Sutton-street, Clerkenwell, Middlesex, manufacturer, for improvements in the manufacture of candles. December 9; six months.

George Lawrence Lee, of Holborn, lithographer, for improvements in producing ornamental designs. December 11; six months.

Edmund Hartley, of Oldham, Lancaster, mechanic, for certain improvements in machinery or apparatus to be employed in the preparation and spinning of cotton and other fibrous substances. December 11; six months.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co. Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1324.] SATURDAY, DECEMBER 23, 1848. [Price 3*d.*, Stamped, 4*d.*

Edited by J. C. Robertson, 166, Fleet-street.

STANLEY'S REGISTERED ROLLER MILL FOR CRUSHING GRAIN, SEEDS, COLOURS, ETC.

Fig. 1

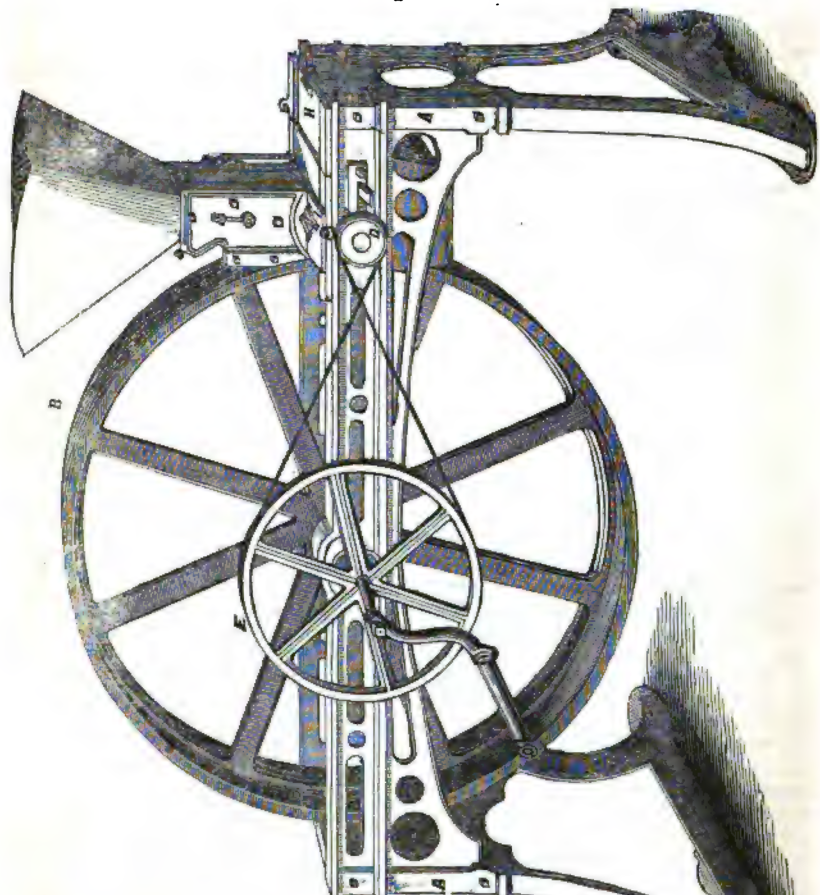


Fig. 2.

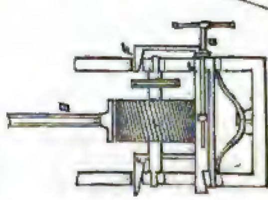


Fig. 3.

STANLEY'S REGISTERED ROLLER MILL FOR CRUSHING GRAIN, SEEDS, COLOURS, ETC.

[Registered under the Act for the Protection of Articles of Utility. William Prockter Stanley, of Peterborough, Ironmonger, Proprietor.

Fig. 1 is a perspective view of this machine in its complete state. Fig. 2 is a longitudinal section of the hopper and crushing roller; and fig. 3 is an end view, partly in section, of the crushing roller and its bearings.

AA is the framework; B, the fly-wheel or crushing cylinder; C is a roller for the crushing of such articles as peas, beans, &c., to adapt it to which purpose it has spiral serrated grooves cut upon its surface. When finer seeds or substances are to be crushed, a plain roller is substituted for the serrated one, which can be easily done by unscrewing the caps, I I. D is a rigger on the roller spindle, which is driven by a gutta percha or leather band from the wheel, E, which is affixed to the shaft of the fly-wheel, B. By this arrangement, the machine is prevented from being choked by over feeding. FF F'F' is a double wedge-piece of metal, which is made to act upon the bearings or brasses of the roller, C, by means of the screw, G, which has its bearing in the framework of the machine. As this screw is turned round to the right or left, it causes the roller, C, to advance towards or recede from, the crushing cylinder, B.

The wedges, FF, being contrary in their action to FF', the crushing roller is thereby always kept steady in the framework, and must at once answer to the turning of the regulating screw, G.

H, is a slide to prevent the broken seed from flying up.

PHILOSOPHY AND POVERTY.

"Tells you *how good* he is—that is, *how rich!*"

A magniloquent denunciation of the poverty of scientific men has appeared in the *Philosophical Magazine* of the present month—in a place where we cannot but express our extreme surprise to have met with such a vulgar and tasteless tirade. That work has always been remarkable for its impartial and honest support of the claims of men of science, and for placing their labours before the world, irrespective of the social position of the authors themselves; and we cannot bring ourselves to believe that the Editors had seen the *drift* of the passages we are about to quote, or were aware of the tendency of the imputations conveyed in them. Perhaps the best apology that can be offered is—that the real object of the Review in which it appears, was an *electioneering one*, to influence the votes for the Secretary by throwing out *personal insinuations* against Mr. Bell's supporters. We only regret that this excellent periodical should have been so led astray as to peril its respectability, and still more to peril its usefulness, by descending into the arena of party-strife.*

Here is the passage: it being premised that it appears in what is professedly a Review of Mr. Weld's "History of the Royal Society:"—

"Athough the Royal Society has subsisted on the voluntary contributions of its own members, it has not been without munificent gifts. Among the earliest of these was the present of the celebrated Arundelian Library, consisting of several thousand printed volumes and numerous manuscripts. On this occasion, it was whispered that the Society were as much obliged to Evelyn as to Mr. Howard—but we dislike looking a

* The contest lay between Mr. Bell and Mr. Grove, (no other changes, it appears, having been deemed feasible at the moment) as successors to the Secretaryship left vacant by the *forced* retirement of Dr. Roget. The numbers for Mr. Bell were 134, and for Mr. Grove 108. Had Mr. Grove not been the nominee of the Marquis of Northampton's Council, he would have been undoubtedly elected: whilst, on the other hand, had Mr. Bell been less tainted with suspicion for his part in the censured doings of the Physiological Committee of the Royal Society, and withal a *physiologist in reality*, he would not only have been elected by an overwhelming majority over both the others—but he and Mr. Grove would have been *the* secretaries elected. The whole affair, however, has been one discreditable alike to the Council and the Society, and admits of no better explanation than that given by Dickens of the Eat-and-Swill election of a member for the House of Commons.

We intend at no distant time to give a tolerably full account of the recent events that have occurred in the Royal Society; and if our readers be not surprised by those revelations, nothing in this world can surprise them.

gift-horse in the mouth: other presents and considerable benefactions have followed; still Mr. Weld shows how often the proceedings have been interrupted, and even the fraternity endangered, by pecuniary difficulties. Indeed it is painful to notice the loss and inconvenience even now occurring to the establishment by the mean backwardness of some of its members in paying their moderate subscription. Much pseudo-sentimentality has been expended on this topic, and we believe idly expended; our own opinion being that those who can, *won't* pay; and that in 98 cases out of 100, the defaulter is more deficient in principle than purse, and exercises sheer and *propense* fraud. If a person is so pressed by his circumstances that he cannot pay, surely he ought to resign; but such is only the exception to the rule of defaulting, and we think that the energies of the laws have been allowed to slumber too long. As to those who wilfully cheat the Societies to which they have signed obligations, we hold that they forfeit the character of gentlemen in the act, and should be proceeded against. In the present day the councils have little excuse for allowing any losses of the kind, since there is the ready aid of the county courts—the which we are happy to state, have just been appealed to with great success by the Zoological Society." —*Phil. Mag.*, *Dec.* 1848, *p.* 474.

Could this paragraph have been written by a professor of *clairvoyance*—one who could see deep into a mill-stone—one who could see not only into the banking book of his *confrères* by bribing a clerk, but feel into their very pockets after the manner of the metropolitan *chevaliers d'industrie?* How else *dares* any man, vulgar-minded as the paragraph shows him to be, come forward and assert that the members of every such society "can but *won't* pay?" The italics we have given in the extract are our author's—not ours. His *clairvoyance* is however at fault, not only in respect to his neighbour's pocket, but even with respect to facts themselves; which a little common place inquiry might have saved him from. The Royal Society "establishment" (so termed, we presume, from the writer having his own "establishment" in his thoughts at the moment,) happens to admit of no "defaulters" under any circumstances whatever. If a member do not pay on a given day, *his name is fixed up in the meeting-room and in the library;* and in three months, without the formality of an expulsion, he ceases by the laws of the Society to be a Fellow. How then can this "establishment" suffer from the "*mean backwardness* of the Fellows to pay their *moderate* subscription"? As to what is "moderate," opinions may differ: but we should be led to think that a considerable number of the Fellows (professional men especially) do not think it moderate. At all events, the member who does not pay, virtually withdraws from the Society; and the establishment can never be in the predicament that this purse-proud writer affirms. These facts are indeed so well known to all the Fellows, that there can be no apology for the writer's mistake. Was it indeed a mistake, or was it "a deliberate misrepresentation"? Or was it written at haphazard to answer some purpose in the last election? In any case it is an unworthy stigma upon those members of the Society, whose pecuniary means may be more limited than the author's own. Poverty in the Royal Society, indeed! What right has the poor man to the honours of science? It is tantamount to a contradiction of terms—as contradictory as the idea of "short commons" in Buckingham Palace.

There have been poor men, however, in other ages, whom even the scientific money-grubs of our own age deign to admit were men of science. Even Newton was obliged to apply to this self-same society to be excused the payment of his shilling-a-week-subscription on account of his *poverty;* but had that event occurred *now*, he would have been paraded by this reviewer "more deficient in principle than purse," and accused of "cheating the society":—he would have "forfeited the character of *gentleman*," and been "proceeded against in the county courts!" In this golden age, "when the veriest fool gets rich," it is held that there is no apology for the philosopher being poor. Our very laws proceed upon the assumed identity of poverty with crime; the peasant or the artizan who can no longer work is shut up in a bastile - prison, and subjected to harsher treatment than the convicted felon! Nor does the spirit of this system end here—it proceeds higher up, and only stops short with the great and titled state-paupers. We see it, too, in

literature and science; we see it fully manifested by this writer: and we see it virtually acted upon in the several societies that profess the deepest veneration for unadulterated mental and physical research. Well, indeed, might a recent writer exclaim :—

"'Money! money!! money!!!' is the cry of all the societies: money is their life's blood: money, the galvanic influence which moves their hearts and moves their tongues: it is their body, soul, and spirit. Deprive them of money, and you deprive them of everything: refuse them your cash, and you annihilate them! 'Even love can't live on flowers'; and science, literature, and art, like patriotism and the priesthood, must be fed on gold and good things, if their existence be a national object! What a soul-less and benighted people we should be if we had neither gold nor bank paper!"—*Wade's London Review,** 1845, p. 586.

"Much *pseudo-sentimentality* has been expended on this topic, and we believe *idly* expended," says the philosopher in question. Is it then *only* "sentimentality" to be poor?—Oh, yes, more —it is "pseudo-sentimentality:"—sheer affectation,—and nothing else. It is *affectation* for a man to wish to pay his debts, and struggle to do it, if he keep the society waiting a single hour for his "moderate contribution." It is affectation for him to wish to clothe and feed his wife and children in the most moderate manner, at the inconvenience to the society of the "moderate contribution" standing over. He must pay this, whatever privations and difficulties he may encounter; or he "forfeits the character of gentleman," and commits "*propense* fraud." The only alternative left him by this organ of the society's views is to "resign"—that is, to acknowledge that (in spite of all his writings) he is *not a man of science,* and to proclaim to the world that he has *no rightful claim* to the character which he has borne, perhaps, for many years! Really the council and its organs are putting forth bold doctrines; but we suspect they little dream of the conclusions, *ex absurdo,* to which those doctrines lead.

In the first place, the title "F.R.S. and its immortal and ubiquitous *et ceteras*" are plainly declared to be granted in consideration of the *fees,* and not in consideration of the bearer's *science.* They are only to be obtained in consideration of the fees, however eminently a man might have distinguished himself by his scientific discoveries:—and enjoyed, too, at the risk of being stigmatised as a "cheat" in case his pecuniary circumstances should, at any future period of his life, become unprosperous! Let it then be distinctly understood as put forward by the organs of the councils of these societies, that *fellowship is a mere matter of purchase—accessible to any demi-idiot who can pay the fees, but closed against the most eminent of our race, if wanting in this essential particular.* Napoleon called us, as a people, "a nation of shopkeepers;" but even he little dreamt of the shopkeeper-spirit which pervades our *scientific* "establishments." It is now not only acknowledged, but unblushingly avowed!

In the second place, it compels those men who have the least regard for their reputation as men of science, to take immediate measures for placing the conditions of fellowship upon some basis that shall distinguish themselves from the crowd of "feeble amateurs" that "merely pay and work not." The title "F.R.S.," or "F-anything," is now proclaimed to be as undeserved by them, as by my Lord Noodle, Colonel Doodle, or Squire Poodle, who can afford to pay the fees. They are *publicly disgraced* by the use of those symbols; and nothing can wipe off the disgrace as long as they sit down supinely under the stigma. Great effort and untiring perseverance will be needed: but if the really scientific portion of the several societies would cordially unite, nothing could withstand their power. It is true that such a writer as the one in question may call them, as he has done, the πολλοί of the society; but who and what is *he,* to talk thus? Let him show his own credentials first,—if only out of common decency.

In the third place, since *fellowship* in all these societies is a question purely pecuniary, every man who has the least

* There are manifest traces of the articles from which we quote the above passage having been not only seen but *used* by this libeller of poverty. We wish, however, that he had been able to seize the *spirit* of those criticisms.

self-respect, founded upon *scientific grounds*, will repudiate the doubtful—nay, the stained honour—of "F-anything." A great number of them, indeed, have "compounded for their annual payments" — ourselves amongst them — and cannot, of course, withdraw; but they can (without sacrificing their privilege to *act* in better times, if better times should ever come) cease to affix these disgraced symbols of their bondage to their names in the books and the papers which they may publish hereafter—at least till "F.R.S." shall cease to be, as it has sometimes been interpreted with great truth, "A Fellow Remarkably Stupid." We know, at any rate, that many of the most distinguished Fellows of the Royal Society have already, and for years, adopted this system; and that the number is still on the increase. *All true men will join them; and that man is false to his own honour, as well as to society at large, who for any temporary motive, shall fail to range himself under the same class of reformers. This is no time for trifling, or for the adoption of temporising measures.*

The ZOOLOGICAL SOCIETY is held up by this organ of the Royal as a model for the "councils" of other societies, viz., to go to the "County Courts." Why not to the PALACE COURT—at least for the "twelve-mile circle" round Scotland-yard? The *suitor* there is sure of his verdict; no questions asked—no evidence allowed beyond that offered by the suitor himself. The "energy of the laws" need not have "slumbered" so long—at least for the London district; but perhaps the beautiful simplicity of the processes of that court were unknown, even to that Society which "pokes its nose into all sorts of strange places," the Society of Antiquaries, till "Jacob Omnium" (Mr. J. J. Higgins), brought it to light. This gentleman ought to be enrolled an "honorary fellow" of all the societies in the metropolis, in pure gratitude for his discovery of such a powerful engine for *extorting fees*. It is a mine of pure gold to them; it is as good as Solomon Jericho's bosom-bank,* when his heart had been "coined" into hundred-pound-notes. They will, too, have this advantage, that by the issue of *weekly* (*writs*, which are returned in succession by the "officer of the court," indorsed "cannot be served,") they may run the costs up to twenty, fifty, or a hundred pounds, upon a claim made for two, three, or four pounds! The "councils" will play a safe game, no doubt; for they can then, by a general inventory of the "defaulter's goods and chattels" (gained from some one of their own clique, who is acquainted with the said defaulter), form a pretty fair estimate how far they can go, so as to perfectly ruin him, and yet secure their own claim. "Dead men," it is said, "tell no tales;" and it is equally true that the tale of a ruined man excites little consideration and less sympathy. Oh, the glorious machinery of the law! but how much more glorious when the law is set in motion by the "councils" of science! But expedition is requisite; for this machine is rapidly wearing out! Nevertheless, the County Courts still remain—at least till some of the "Law Lords" can devise a new connundrum, to be deemed "perfection" till the consecutive session of Parliament.

Seriously, however, it is lamentable to see any man coming forward with such doctrines, as the organ of the Royal and other Societies; and still more so to see those doctrines circulated by means of the oldest, and, in some respects, the highest in character, of our scientific magazines. It bodes ill for science, when it is to be enforced by law-writs; and especially when those courts are put in motion against some of the ablest scientific men of this country—men who have been more intent upon science than gain, and who, because they fail in getting money, are to be deprived of recognition by their fellow-men, *as men of science*. Nay, when even to urge this is called *pseudo-sentimentality!* and when, to fall into confined pecuniary circumstances, brands a man as a "cheat" and "no gentleman." We should like to know, however, the social and intellectual status of this libeller, or, rather, we should like to have his own authority for stating it, as we believe we *know* it already. In truth, the very style of it bespeaks a vulgar nature and an illiterate mind;—however filled the purse may be.

We cannot, however, close without one short quotation more from this singular document.

* Douglas Jerrold's "Man Made of Money," *passim*.

"Though the $\pi o \lambda \lambda o i$ are noisy and *rudent* [*'Rudo*—to bray like an ass, to roar,' Entick's Latin School-dictionary] at elections and the like, *they are, of course, excluded from the honours and consideration of the Society*; that is, *from their state and condition, they are not likely to be* SELECTED BY THE COUNCIL to read the Croonian or Bakerian lectures, which are followed by a small pecuniary reward; nor are they likely *ever to aspire* to the Copley, the Rumford, or the Royal Medals."

There is a wide and characteristic distinction, which this writer proves his incapacity to appreciate, between the mere servile pursuit of science, *for the sake of reward*, and the pursuit of truth *for its own sake*. He assumes that the former is the *only motive* of the man of science; and we may infer that, if he has done anything at all, it has been done from *selfish and mercenary* motives. How can he say otherwise, when he allows no higher motive to any other man? "Out of thine own mouth thou art condemned."

The writer, however, had evidently before him the letter of Dr. Marshall Hall to the Earl of Rosse: and it is equally evident that Dr. Hall is here intended to be classed amongst the $\pi o \lambda \lambda o i$, perhaps as the principal of them. Be it so; of Dr. Hall's treatment at the hands of the Royal Society, we do not intend to speak just now; but we think the following dictum of M. Flourens, perpetual secretary of the French Institute, may possibly bear as much authority as that of the purse-proud libeller in the *Philosophical Magazine*.

"The three great epochs in physiology are marked by Harvey's discovery of the circulation of the blood; by Charles Bell's discovery of the sensitive and motor nerves of the spinal chord; and by Dr. Marshall Hall's discovery of the reflex function of the spinal marrow."

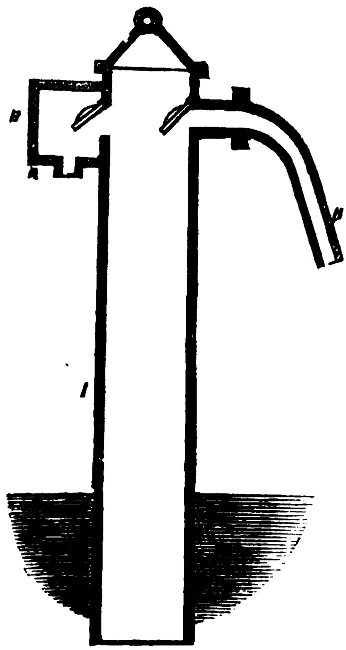
The fact is that the man must be moon-struck who should "aspire to the Copley, Rumford, or Royal Medals," on the ground of his *science only*—and especially so on the ground of PHYSIOLOGICAL SCIENCE. Subserviency, meanness of nature, perfect readiness to abet any injustice contemplated by the council, and a thick-and-thin defence of all the measures of the *clique*—these are the qualifications for medals! Scientific men, as such, and especially in a position of professional competition with either of the secretaries, or with the permanent councillors, need not "aspire" to the honour of a medal, nor even to the "small pecuniary reward" which Dr. Croone and Mr. Baker bequeathed to the Council's keeping. We can see a Newport, a Beck, or a Galloway medallised; but we look in vain for a recognition by the council of the splendid discoveries of Dr. Marshall Hall; and even the recognition of Mr. Adams was delayed so long that all Europe cried "Shame!" whilst Le Verrier was medallised with the most indecent haste in despite of the most ample proof of Adams's priority. "Aspire," indeed! We are indeed sorry to find any man of genuine science so ignorant of the doings of the Royal Society, as to "*aspire* to the honour of a Copley, Rumford, or Royal Medal." A medal is now no honour—and the non-medallised fellows, who have claims to urge as scientific men, will stand all the better in the eyes of posterity for that very circumstance. Let them be content: the society cannot honour *them* in any way; whilst, on the other hand, they would only degrade themselves by the acceptance of a PINCH-BECK MEDAL!

VENTILATION OF SHIPS.

Sir,—The suffocation of a number of persons in the *Londonderry* steamer, is calculated to cause a thrill of horror in every place where the account is read, and to recall the recollection of the *black hole of Calcutta*.

Cattle have been often suffocated in ships, from want of proper ventilation; but this recent loss of a number of human beings, must excite increased attention to the subject of ventilating vessels.

It is to be hoped that this sad occurrence will lead to the adoption of the best means of ventilation. In 1820, Mr. Perkins proposed to ventilate ships by means of their motion. Two tanks, containing some water, were connected by a pipe; in the motion of the ship, the water flowed from one tank to the other, and a hose conducted the foul air to replace the water. When the water flowed back again by the ship's motion, the air was expelled through another hose. Valves were placed so as to admit foul air into the tanks, and valves were



used to allow it to escape. This plan was good; but in some ships room could not be well afforded for tanks.

My attention was directed to obtain ventilation by the motion of a ship, with an apparatus that would not be much in the way.

In 1824, in a small work containing some observations on ships, I proposed a plan which will effectually ventilate; but I did not give a drawing of the apparatus. I now send a sketch of it, in hope that by the extensive circulation of the *Mechanics' Magazine*, the plan may be more generally known, and that it may be the means of preventing a calamity such as occurred aboard the *Londonderry*. *Certainly no such calamity could have occurred if the steamer had been furnished with this apparatus.*

A tube from the ship dips into the sea; to the upper part, a hose is connected: the hose goes down to the part of the ship where foul air collects. There is a valve to allow bad air to pass through the hose, but it prevents the return of such air. In the motion of the ship, the tube that dips into the sea is sometimes deeply immersed in the water, and the water forces the air in the tube up and out through a valve in the side of the tube.

When the tube is not deeply immersed, the water in it finds its level, and foul air from the ship rushes through the hose to occupy the place of the water which was high in the tube. In the next immersion of the tube, the water will force the foul air out through the valve. Thus ventilation will go on by the motion of the ship; and the apparatus will not be liable to get out of order. It is not complicated; it is cheap, and does not interfere with useful room in a vessel. The tube may go down from the ship to the sea at the stern, or it may be placed at the bow. If placed at the bow, the tube should be curved to adapt it to the shape of the bow. The top of the tube is closed by a conical cap screwed on. This cap can be taken off when the valves are to be put in, and it can be screwed on again.

The hose can be screwed on to the tube, and then can descend through a small aperture into the ship. Over this aperture there should be a covering of timber, to protect from the weather the hose, and to prevent it from being trampled on. The covering could be removed if we should wish to unscrew the hose from the tube.

To prevent strong winds from checking the opening of the valve through which the foul air issues, the valve is sheltered by a box, and the air escapes through an aperture in the bottom of it. The reason why the aperture is not at the top, is lest rain should get into the box.

In the figure, T represents the tube; H, the hose; B, the box sheltering the valve; A, the aperture through which the foul air escapes from the box.

When bad air is drawn out of a ship, fresh air rushes in through every crevice to occupy its place. Ventilators of this kind are well fitted for emigrant ships. Shippers of cattle would, no doubt, patronise vessels provided with such ventilators.

I am, Sir, yours, &c.,

JOSEPH M'SWEENY, M.D.

Cork, December 13, 1848.

REMINGTON AND WHITTON'S FARMER'S AND GRAZIER'S PORTABLE MILL.

[Cobett Whitton, of Sixall-heath, Stafford, Gentleman, Proprietor. Registered under the Act for the Protection of Articles of Utility.]

Fig. 1.

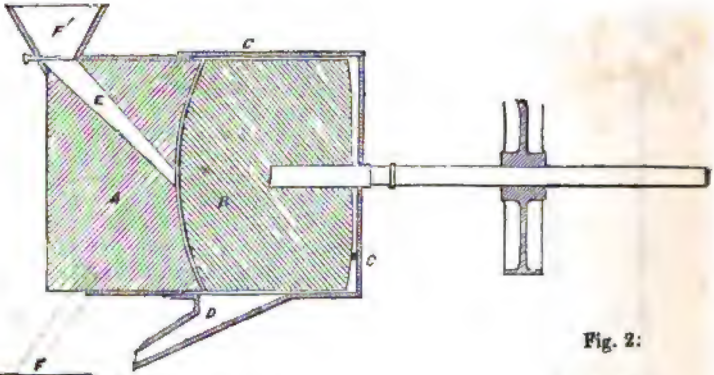


Fig. 2:

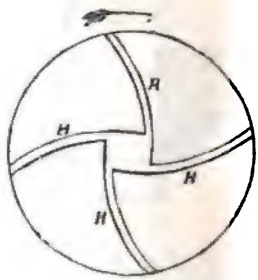


Fig. 3.

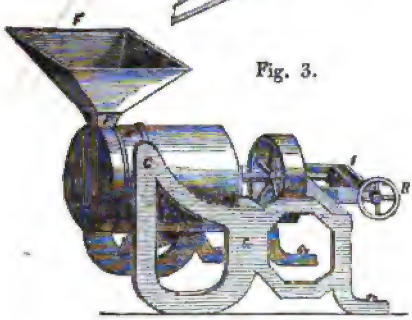


Fig. 1 is a section of the stones and case of this mill. Fig. 2 is a face view of one of the stones, and fig. 3 is a perspective elevation of the machine in its complete state.

A is the stationary stone, and B the running stone; C is a cover of galvanized iron which is fitted as nearly air-tight upon the stones as may be, excepting at the spout, D, through which the flour is discharged; F, is a wooden hopper, which is inserted in another smaller hopper, F', of iron, which last is attached to an iron hoop, B', which encircles the cover and opens at bottom into a feed-passage, E, which conveys the corn between the stones. The rotation of the stone B, in the case C, causes a rarefaction of the air within the latter and consequent pressure of the atmosphere in the direction of the passage; so that the grain always enters between the stones at a rate corresponding with the velocity at which the mill is driven; besides which, the air which enters along with the grain serves to keep the stones and meal cool. G G G is the framing, the side rails of which are placed nearly on a level with the spindle of the driving pulley, which admits of considerable latitude as to the direction of the driving band.

The section of the stones given in fig. 1, shows that the fixed stone is concave on its surface, while that of the runner is convex, which gives greater steadiness of motion and more grinding surface than is attained with stones having straight surfaces. The latter advantage is still further increased by the curves, on the face of the stones as shown at H H H, in fig. 2, being inclined in a direction the reverse of that which the stones run.

I is an inclined plane, by means of which the distance between the stones, and consequently the fineness or coarseness of the meal is regulated, and R the screw by which it is worked.

SANITARY MEASURES.—NO. IV. TYLORS' IMPROVED WATER-CLOSET.

(Registered Pursuant to Act of Parliament.)

RIGHT HAND. GROUND PLAN. LEFT HAND. Fig. 1.

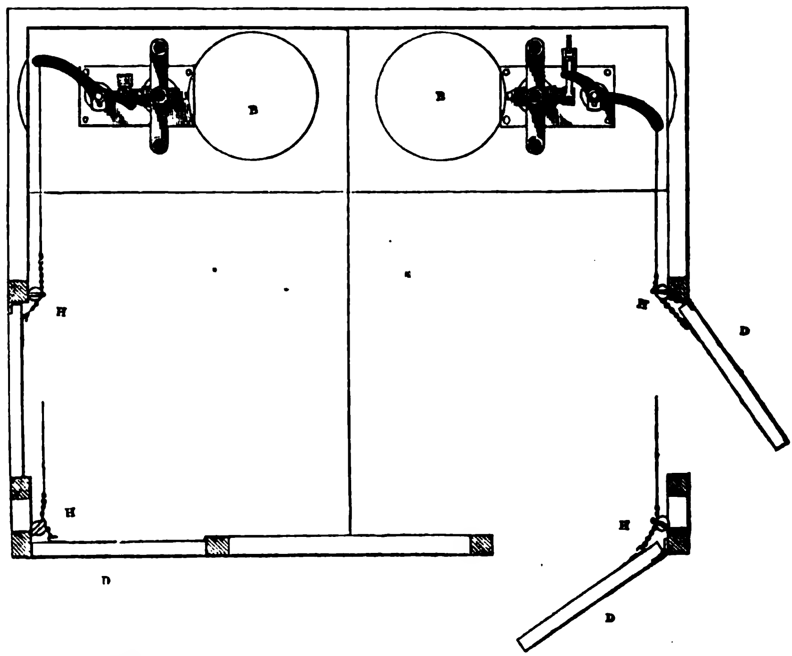


Fig. 2.

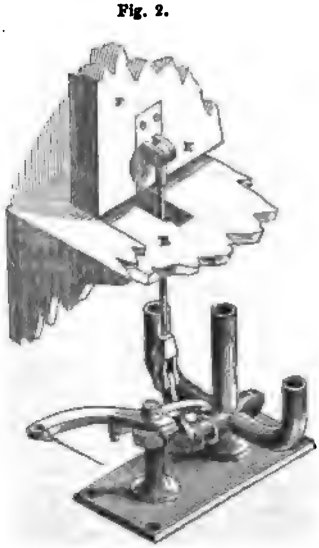
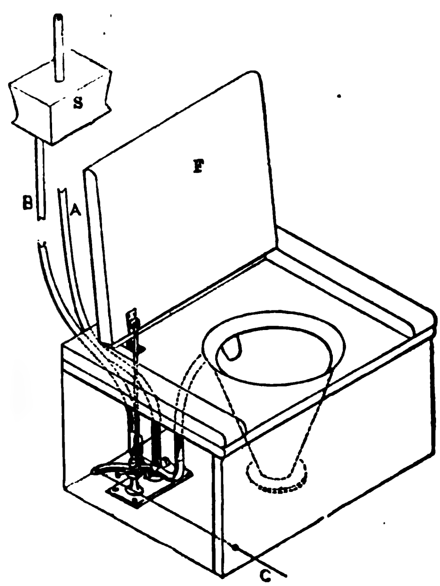


Fig. 3.



Sir,—In carrying out extensive and systematic measures for the preservation of the public health, the effectual voidance of all offensive matters, and the exclusion from our dwellings of pernicious effluvia therefrom, is of the utmost importance.

Accordingly we find a great variety of improvements have been recently made in *water-closets*, having for their twofold objects, to render these contrivances so *cheap* as to make their employment universal, and so *certain* in their action, that they cannot fail to produce the intended results. Of the numerous inventions for this purpose now competing for public favour (many of them of great merit) *Messrs. Tylor and Son's Sanitary Closet* is well deserving of notice. In point of cheapness, simplicity, and efficacy, it has few equals; and, although, strictly speaking, it is not self-acting, yet its operation is made dependant upon circumstances, which inevitably bring about the required action. That is to say, the opening of the lid to use the closet, and the opening of the door afterwards to leave it, effect the filling and discharging of the service-box, without, nay, even in spite of, the interference of the user, who in this portion of the affair plays but the part of an *automaton.* The manner in which this is accomplished will be at once understood on reference to the prefixed engravings, of which fig. 1 shows a ground plan of a right and left-hand closet; BB, are the places for the basins; and, DD, four eligible positions for doors. Fig. 2 is a perspective view of the working part of the closet; and fig. 3, a perspective elevation thereof, showing the position of the three-way cock, and the arrangement of the pipes, service-box, &c.

A, fig. 3, is a half-inch service-pipe, leading from an elevated cistern, or main under pressure, to a three-way cock on the floor of the closet, shown more distinctly in fig. 2. B is a three-quarter-inch pipe leading from the three-way cock to the service box, S, which may be placed within a cistern or not. There is a third pipe leading from the three-way cock to the basin of the closet. Fig. 2 shows the arrangement by which the raising or putting down of the closet-lid, F, gives motion to the three-way cock, through the medium of the rod, R, which connects the handles of the cock with a knuckle, K, affixed to the under side of the closet lid.

On raising the cover, F, preparatory to using the closet, the plug of the cock is lifted, and turned so as to open a communication with the water supply, which passes from the pipe, A, through the cock and up the pipe, B, into the service box, S, which it fills. On shutting down the lid, previous to leaving the closet, the cock is again turned, shutting off the communication between the water supply and the service box; and opening a communication between the service box and the basin,, whereby the latter is effectually flushed and cleansed. Should the user be too lazy or too negligent to shut down the lid of the closet, this will be done by him on his opening the door to leave the closet. For this purpose a small chain, H, is affixed to the door, which draws forward a wire attached to a lever acting against the handle of the cock and rod, R; this lever causes the closet lid to fall, turns the cock, and effects the required flushing. A small piece of India-rubber on the front corners of the seat prevents any disagreeable noise arising from the fall of the lid. In large establishments it would only be necessary to lay on one water pipe, from which the pipe, A, might branch off to a series of closets; in this case a small air pipe should be carried up from each service box to the level of the water supply; or, otherwise, to use an air-valve. The basin of these closets may be *trapped* in any approved manner, but I consider the best mode of trapping would be by the use of Bunnet's self-acting effluvia trap (described *ante* page 444,) with a syphon beyond.

For public buildings, schools, prisons, railway stations, &c., *Tylor's Sanitary Closet* stands unrivalled, being proof against that reckless inattention to matters of personal cleanliness which frequently gives rise to great annoyance in such places. Decency may "forbid"—politeness may "persuade"—and reason "request," in vain; but so long as the closet-lid and door keep on their hinges, no person can *use*, or having used can get away from *Tylor's Closet* without performing the operation so essential to cleanliness and health—the *emptying and flushing of the basin!*

I remain, Sir, yours respectfully,

WM. BADDELEY.

29, Alfred-street, Islington, Dec. 18, 1848.

THE DIFFUSIBILITY OF THE ELECTRIC LIGHT.

Sir,—On Tuesday evening last, I had an opportunity of observing the effects of the electric light; they were certainly magnificent. Rays of the light were directed by a large lens on different objects at a considerable distance, such as the statue of Nelson, the lion on Northumberland House, and the houses in Charing-cross—the minutiæ of which became very perceptible; although it was evident from the experiment, that common lenses would be unsuitable in practice, owing to the remarkable chromatic rings which attend the light condensed by them.

There is, however, a point which appears to me of importance in considering the applicability of this beautiful luminary to the illuminating streets or great areas,—its diffusibility. Our ordinary modes of illumination are incapable of giving luminosity to the solid and aqueous particles in the atmosphere for any considerable distance; but the electric light effects this admirably. I found that when I placed myself under the wall separating the interior square and the road, so that the direct rays of light could not reach me, I could read a print of ordinary size with ease by the diffused light. A strong objection is made by some persons, that should it be attempted to light any great space where there are many structures, a deep shadow will be thrown by the object, or one side of a street will be in darkness. If, then, it can be shown that the atmosphere can be illuminated by the light after the manner of the sun, the objection cannot reasonably be raised. If a very powerful instrument were raised to a considerable elevation, the extent of this desirable effect might be made the subject of experiment, and it would probably be found that one light at a great elevation will illuminate several streets. I am, &c.,

G. FINDEN WARD.

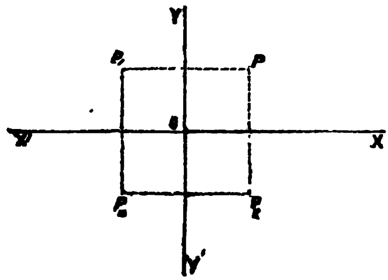
97, Upper Seymour-street, Euston-square.

PLUS AND MINUS.

Sir,—Your correspondent, "R. B.," p. 589, appears to be confounding *equality of magnitude* with *identity of position*. Perhaps the following observations may assist in removing any obscurity, real or supposed.

It is well known that it has been fully explained by most writers on algebra, that any magnitude, such as a^2, may be produced by the multiplication of $+a$ by $+a$, or of $-a$ by $-a$; and he ne *inversely* in obtaining the *factors* of a y magnitude, such as a^2, there is *no reason why* we should adopt $+a$, or $-a$, as the true *generator*, unless we are *previously made acquainted with the mode in which the magnitude has been generated*. The same reasoning evidently applies when we take the magnitude ab, since this may indifferently be *generated* from $+a$ by $+b$, or from $-a$ by $-b$.

Adopting these principles, let us now attempt the interpretation of the magnitude ab in relation to its position in each of the four angles of the annexed figure.



Case 1. Let P be the position of the magnitude, then from *previous convention*, we *know* that it is generated from the product of $+a$ by $+b$, and is correctly represented by $+ab$.

Case 2. Let the magnitude have the position P_1; then, again, we *know*, from *previous convention*, that it is generated from $-a$ by $+b$, and is correctly represented by $-ab$.

Case 3. Let P_2 be the position; then we are still aware, from *previous convention*, that the magnitude is generated from $-a$ by $-b$; and although the correct representation is $+ab$, we are debarred, by *our previous knowledge of its mode of generation*, from confounding it with the *equal* magnitude in the position P.

Case 4. Let the magnitude have the position P_3, and again we *know* it is generated from $+a$ by $-b$, and is consequently correctly expressed by $-ab$. But what prevents us from confounding Case 4 with case 2, since each is *abstractedly* represented by $-ab$? Obviously nothing but our *previous* knowledge of the *mode* of generation; and the same knowledge in like manner prevents us from confounding Case 3 with Case 1.

I am, &c., THOS. WILKINSON.

Burnley, Lancashire, Dec. 16, 1848.

MR. GEORGE REMINGTON'S PATENT IMPROVEMENTS IN LOCOMOTIVE, MARINE, AND STATIONARY ENGINES.

Fig. 1.

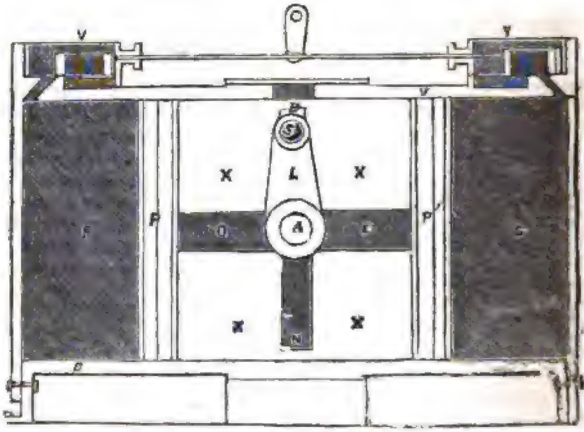
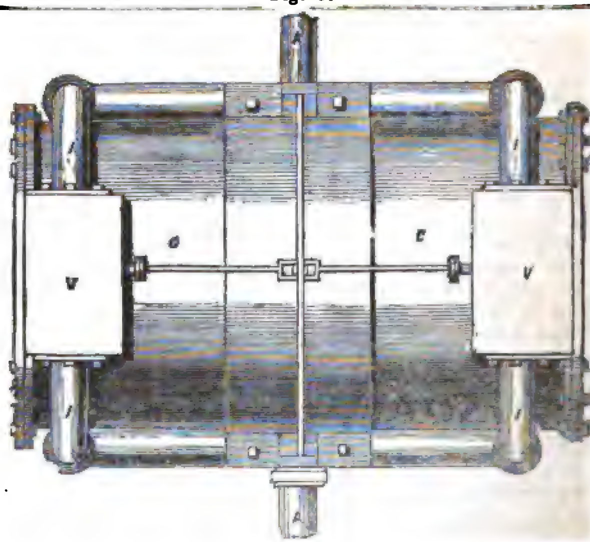


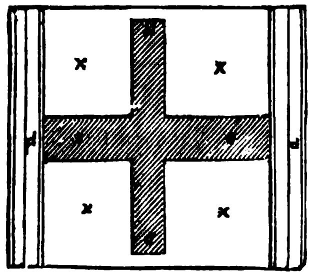
Fig. 3.



We have already given a general description of the improvements described in Mr. Remington's specification (*ante* p. 548,) and propose now to give the details of an engine which has been recently erected by the patentee for the Commissioners of Warkworth Harbour, Northumberland.

Fig. 1, represents a longitudinal section of the engine; X, X, X, X, is a flat plate to which is attached two pistons, P, P′, fitting the cylinders so as to work steam-tight. There are two slots or openings intersecting each other in the centre of the plate, so as to form an open cross (as more clearly shown in fig. 2). The slot or opening in the direction of the line of stroke of the piston is for the purpose of allowing the plate to pass the shaft. The other slot or opening forms a guide for the block, which is attached to the lever by means

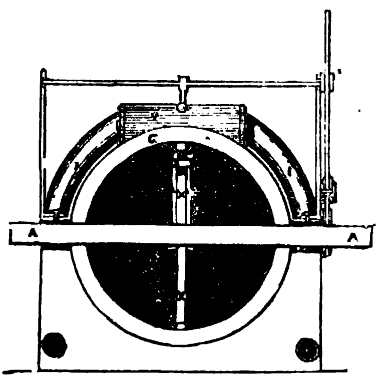
Fig. 2.



of the spindle, *s*. V, V, represent the valves for regulating the admission of steam, which are worked by a single eccentric of novel construction attached to the main shaft outside the cylinder.

In the engine referred to, the cylinder is placed horizontally. Fig. 3 represents a plan, and fig. 4 a cross section of the same. A, axle; B, block; C, cylinder; L, L, levers; P, P′, pistons; S, spindle; V, V, valves; X, X, X, X, the plate with the open cross; I, I, steam pipes.

Fig. 4.



The pistons are shown at half stroke. The block is at the extremity of its guide, and the axle occupies the centre of the cross opening. If steam be entering at the side, the piston, F, will move in the direction of G, and when at the end of the cylinder, the block will be at the centre of the cross opening, and the piston, P, close up to the axle. On the reversion of steam to the opposite end of the cylinder, G, the block will slide down the guide, and at half stroke will occupy the extremity, N, of the guide, and the axle will again occupy the centre of the cross opening. When the piston arrives at the end of the stroke, the block will occupy the centre of the cross, and the next half stroke will complete the revolution, and thus by alternately letting steam to the opposite ends of the cylinder, rotatory motion is produced.

This is a very simple arrangement, and will apparently answer well, wherever saving of space and weight of machinery is an object, as in marine engines. In locomotive engines the working shaft may be straight, and the cylinders may be placed with equal facility either between the wheels or outside of them.

ON THE ELASTICITY OF STONE BULWARKS IN RESPECT TO THE PRESSURE OF WAVES.

Sir,—" A Constant Reader" observes (*ante* p. 559), " The only explanation of this seemingly paradoxical result was given by Mr. Dredge; but if I mistake not, he rests his explanation of the phenomenon upon an assumed degree of elasticity in the material of stone, which, I believe, experience and observed facts would not bear out."

I will not occupy the attention of your readers, nor encumber the pages of the *Mechanics' Magazine*, with any arguments in support of my "explanation" of this " seemingly paradoxical result." If it were possible to find the "angle of repose," much good might be done by discussing a subject of such practical importance; but the mind becomes confused by the number of conflicting elements which have to be taken into consideration, and which seem to render such a demonstration hopeless. Nevertheless, I shall be happy to consider and reply, to the best of my ability, to any specific objection which a "A Constant Reader" may be pleased to make.

The object of my letter (page 196) was to show that the elasticity (I used this for want of a better term) of the material of which a wall is built, has much to do with its manner of resisting a force impinging on it; and that, in a practical point of view, it is exceedingly important that we should require of sea walls other qualities than that of mere statical resistance. Subsequent consideration has only served to strengthen this opinion, and lead me to the conviction that it is of greater importance than I at first thought it to be.

Professor Whewell, in his "Mechanics of Engineering," observes, "All solid substances, as wood, stone, metals. &c., are susceptible of some compression and extension. This compression or extension is greater as the forces producing them are greater; and when the forces produce a compression or extension greater than the texture of the substance can bear, the bodies are crushed or broken."

The sound which a stone gives forth when struck, may be easily made to demonstrate its elasticity. The fact of an arch sinking when its centres are removed, and rising again when weight is taken off the extrados, proves that within certain limits stone may be compressed, and that, on removing the opposing force, it regains its original bulk.

Professor Leslie states the modulus of elasticity of Portland stone to be 1,570,000 feet. This brings the limit of elasticity within extremely narrow bounds, but I really cannot see any reason why the mechanical action of the atoms of the stone should not be as perfect through this exceedingly small space, in which by virtue of elasticity they act, as those of caoutchouc through the more sensible distance in which they act. There can be no doubt of the fact of stone being elastic, within certain limits: its practical effect is another matter. This I shall now proceed to consider under two heads: 1st. When the wave rolls upon the wall, producing a steady pressure, which a receding wave suddenly removes, and, 2nd. When the wave strikes the wall *suddenly* with the impetus of a blow.

1. *When the wave rolls upon the wall, producing a steady pressure, which a receding wave suddenly removes.*

In my former letter (page 196) I endeavoured to explain the effect which the sudden removal of a pressure would have on a wall; I there observed that the pressure of the waves would tend to compress the stone, (the diagrams exhibited were of course drawn to an exaggerated scale) and that on the removal of this pressure, the stone in recovering the original figure would project as far beyond the point of rest as it was compressed within it.

To illustrate this by comparison, let AB, fig. 1, be a bar of iron, and suppose pressure applied at B, and compressed endways to the length of AB′. Now if

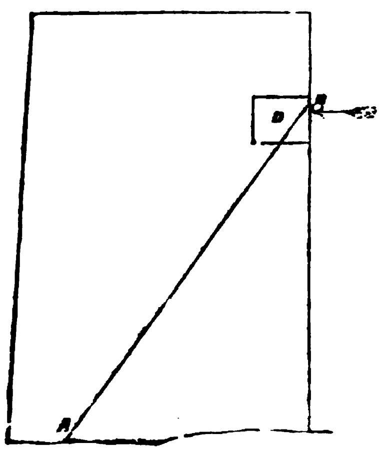
Fig. 1.

this compressing force be suddenly removed, the bar will expand, not to the original length, AB, but at first to the length of AB″, making the space, BB″, equal, or nearly equal, to the space, BB′; it will then contract to the length, A*b*, and afterwards expand to A*b*′; and so on continually oscillating about the point B, until at length it rests at the original length, AB. For the explanation of this principle, see "Moseley's Engineering and Architecture," page 494.

The modulus of elasticity of wrought iron is 9,000,000 feet, that of stone 1,570,000 feet. The weight of a cubic foot of iron is 487 lbs., of a cubic foot of stone 151 lbs. The pressure therefore of 1 ton per square inch will compress a bar of iron $\frac{1}{12000}$th part of its length, and the same weight will compress a prism of stone $\frac{1}{804}$th part of its length.

Now, suppose the length of the line of resistance, AB, fig. 2, drawn diagonally through the thickness of a wall be

Fig. 2.



40 feet, and the pressure on the surface of the wall 3·5 tons per square foot, the line AB will be compressed about the $\frac{1}{500}$th part of a foot, and on the removal of the pressure, the line will be lengthened as much as it was previously com-

pressed, and if such increase in the length of the line pushes the stone, D, beyond the point at which it can recover its original position, permanent injury is the result. It is very true that the $\frac{1}{800}$th of a foot or the $\frac{1}{66\cdot6}$ of an inch is a very, very small space, but 66·6 repetitions of this will make it an inch, which becomes a serious matter.

In this climate the thermometer ranges through an extent of 76°. Professor Daniell found by accurate experiments that wrought iron varied within the extremes of the range $\frac{1}{2000}$th part of its length. Thus, if a bar be 40 feet long, in the depth of winter, it is in the hottest day of summer 40·02 feet long. Every one is aware of the injury produced by the expansion and contraction of metal bars if fixed to stone work, and since the mechanical action is the same whether the expansion of the bar is produced by heat or by the reaction of pressure, is it not reasonable to suppose that if a bar of iron, by being expanded from 40 to 40·02 feet, produce an injury to the stone work to which it is attached, that an expansion consequent upon reaction from the sudden removal of pressure, of double this, or from 40 to 40·052, may be productive of injurious effects?

2. *When the Wave strikes the Wall suddenly with the force of a blow.*

Water suddenly impinging against a surface strikes it, at the instant of impact, with comparatively as great a force as a solid body having the same momentum would. Of this a person may satisfy himself by falling flat on the surface of the water, when his system will suffer as severe a shock as if he had fallen on the hard ground. A man will suffer a stone of 500 lbs. to be broken on his chest by means of a sledge hammer, without himself suffering any great inconvenience from it, but $\frac{1}{10}$th of the *pressure* necessary to break *the stone*, would crush the man. The reason of this is, that the force of the hammer at the instant of impact is expended in disorganising the structure of the stone. Does not the sea strike upon the surface of a breakwater comparatively as the sledge hammer strikes the stone? Is not the striking of the stone analogous to the concussion of the face of the wall? May not the man's chest supporting the stone, be compared to the interior backing of the wall? And does not the fact, that the man receives no shock from the breaking of the stone, give rise to grave doubts as regards the value of the backing, leading one to infer that the face of the wall when suddenly struck has to resist the full force of the wave? I confess this appears to me very likely to be the case, and leads me to infer, that as the man receives but little inconvenience from the blow of the sledge, so, when the face of the wall is struck with a sudden blow, the backing does not afford the full support intended, and that the face of the wall has therefore to perform a greater duty than it is in many instances capable of performing.

I had got thus far, when I observed that a letter written by "A Steam-ship and Water-wheel Engineer," published in your Journal of this day (Dec. 16) contained some observations upon a communication of mine which appeared on the 2nd instant. I answer his objections categorically:

1st. He says, "For the mere purpose of denoting the diminution of force arising from the obliquity, it is indifferent which expression is used for q." Your correspondent misunderstands me; I never stated that it was necessary for comparative discussion, to give a more specific valve to q; that quantity might be altogether expunged from the expression without being missed; AC $\sin^2 \phi$, instead of AC$q \sin^2 \phi$, would answer quite as well "for the mere purpose of denoting the force arising from the obliquity." What I intended by putting

$$q = \frac{S\,(2f + a\,S)}{2}$$

was to give the equation a practical value, and not a theoretical or speculative one—to show the absolute work expended by the sea upon the wall. What I said was, "All *calculations* founded on such data (*i.e.* $q = 3\cdot5$ *tons*) must be wrong."

2nd. "I hope Mr. Dredge will pardon me, however, if I say that though his two expressions (p. 588, col. 2,) for the effect of the waves have the same meaning, yet the second will assuredly lead most practical men to form an erroneous opinion concerning the law of pressure."

I am not going to quibble about which of these equations the practical man would best understand. What, by my

observations I wished to show was this, that they are identical—and that your correspondents were disputing on a subject in which there is a distinction without a difference. Though I shall not dispute it, yet I doubt if most practical men would prefer one equation to the other. And in corroboration of this, Sir Howard Douglas, who is a practical man, says it should be $ACq \sin^2 \phi$.

Mr. Smith, of Wexford, who is also a practical man, says it should be $ABq \sin^3 \phi$.

I am a practical man, who say that either $ACq \sin^2 \phi$, or $ABq \sin^3 \phi$, may be used, for they are both the same in effect and substance.

3rd. I cannot understand why, if your correspondent "grants that the pressure on any moving body, multiplied by the space moved in a given time, is a convenient measure of the power exerted," he should object to it. By putting

$$q = \frac{S\,(2f + a\,S)}{2},$$

it is intended to express it in a convenient form for practical purposes. All I wished was, to obtain a "convenient measure of the power expended" by the sea.

I cannot subscribe to his subsequent observations relative to impact, nor do I think they will be borne out by any authority on the subject. One thing is certain—the violence of a blow depends as much upon the hardness and resistance of the surfaces of the bodies in contact as it does upon the *vis viva* at the instant of impact.

In conclusion, I would again observe, that I put

$$q = \frac{S\,(2f + a\,S)}{2}$$

to express the work expended by the sea, and registered by the marine dynamometer. If your correspondent will show me that it does not do this, or if he will show me that it is not a general equation applicable to effect of impact, I shall be happy to consider his objection; and if he prove me in error, to record my conviction in the pages of the *Mechanics' Magazine*.

I remain, Sir, yours obediently,

William Dredge.

London, 10, Norfolk-street, Strand,
December 11, 1848.

TREMBLEY'S COMBINED VAPOUR ENGINE.

An engine of 10-horse power, the invention of a M. Trembley, a Frenchman, may now be seen in operation on the premises of Messrs. Horne, 14, High-street, Whitechapel, in which, by a combination of the powers and properties of steam and the vapour of perchloride, results are produced by which machinery is worked at 50 per cent, on the cost below the expense of the common steam engine. The first engine constructed on this principle was exhibited in Paris in 1846, and the success of the experiments was admitted. There is now an engine on the same principle at work in a glass-manufactory at Lyons, which is of 35-horse power; in it either is used, by the vaporization of which the force is obtained. This invention is understood to have the approval of the French Government, and to be sanctioned by the high authority of M. Arago. The French Government appointed commissioners, with M. Lafont, an officer of the Marine, at their head, to test the working of it. The experiments were made in July last, and the report made to the Government confirmed the results obtained by the experiments in 1846. In the engine now at work at Messrs. Horne's, perchloride has, on the suggestion of M. Arago, been employed in the place of ether. The perchloride is an agent, from the vaporization of which no danger can arise from explosion or combustion; it is uninflammable, and may be poured into a red-hot iron ladle with perfect impunity, nothing being produced but vapour from the experiment. The object of the inventor is to form a company in this country similar to what has been formed in France, and by their means to bring his invention into operation on a large scale. The account which is printed of the invention will perhaps convey as correct a notion of it as can be conveyed without personal inspection or the use of models or sectional diagrams:—This invention is applied either to a single engine with two cylinders and pistons, or, as is usual for maritime purposes, two distinct engines with a cylinder and piston each. In either case one of the pistons is acted upon by steam, and the other by the vapour of perchloride, or of any other easily vaporized liquid. The steam power is generated and applied as in the ordinary engine; but upon the escape of the steam from the first cylinder, after having exerted its expansive force therein, it passes into an air-tight case, termed a vaporizer, containing a number of small tubes charged with perchloride or some easily vaporized liquid, penetrates into the space between, and comes in contact with the entire surface of the tubes. The faculty

of absorbing caloric possessed by liquids of the before-mentioned class is so powerful, that immediately upon the steam coming in contact with the surface of the tubes charged therewith, a large portion of the caloric of the steam is absorbed by the liquid in the tubes, which becomes thereby vaporized; and the steam being thus deprived of its caloric, is immediately condensed, and is then returned into the steam boiler. The vapour thus obtained by the action of the steam, or perchloride, or other liquid in the tubes, is conducted into the second cylinder, and after exerting its elastic force (which is greater than steam) upon the piston in the second cylinder, is condensed, and by means of a force pump is returned into the vaporizer, which it thus keeps regularly supplied, and is alternately vaporized and condensed." The saving effected by this engine, is in the small quantity of coals required for the steam, the smaller room occupied by it, and the avoidance of incrustations in the boiler, the water being completely distilled by the reiteration, vaporization, and condensation. The perchloride is a very cheap fluid; when once charged, the quantity in the tubes will last a considerable time, the alternate condensation and vaporization occasioning a very trifling loss in the bulk or quantity employed.—*Times.*

For some further particulars of this engine, see *Mech. Mag.*, vol. xlvii., p. 599.

RAILWAYS FOR MOUNTAINOUS DISTRICTS.

Sir,—Having some time ago turned my thoughts to the possibility of extending the ramifications of railway lines through districts which are considered to present engineering difficulties of a nature calculated to render such means of communication altogether impracticable, I have devised a plan by which these difficulties may be overcome, and those important highways of modern introduction, carried through countries abounding in hills, and even over lofty mountain ranges, without having recourse to deep cutting, expensive tunnels, or steep embankments; and as I think the subject is one of vast importance to the public, I avail myself of the columns of your widely circulated Magazine to present the advantages of the system I propose in a prominent point of view.

My plan, then, is, after having selected the best section that the country will afford, to lay down upon it such gradients as would be best suited to the nature of the ground without exceeding a maximum rate of inclination—say 1 in 100; and when, from the nature of the country, a steeper gradient would seem necessary, would have recourse to moveable platforms, by which I would raise or lower the trains by means of the hydraulic press, so as to arrive at a new level, on the principle of a series of locks, as exemplified in our ordinary canals.

By this plan, not only could railways be introduced into countries hitherto inaccessible to locomotives, but *inclined planes* (exceeding 1 in 100), might be completely dispensed with, while the saving upon heavy works of construction would be immense.

In conclusion, I may observe that its advantages would be almost incalculable in the mining districts of Russia or South America, where many mines of great value are left unworked, from the difficulty of conveying their products across intervening mountains to the place of their destination. It would be further found most useful in *all* mining districts, as the railroads might thus be continued into the very depths of the mines themselves. I am, Sir, yours, &c.

Wm. H. V. Sankey,
Civil Engineer.

Hibernian Hotel, Dawson-street, Dublin.

VULCANISED INDIA-RUBBER JOINTS FOR WATER AND GAS SOCKET PIPES.

[From Report by Thomas Wicksteed, Esq., Engineer to the London Water-works, &c.]

On the 29th February last, Mr. Brockedon* called my attention to a new method of making the joints of socket pipes for water and gas. He exhibited a spigot and socket pipe made of glass of 2 inches bore, and upon the spigot stretched a ring of vulcanised India-rubber, the external diameter of the ring, when stretched, being greater than the internal diameter of the socket into which it was to be introduced. In stretching the ring upon the extreme end of the spigot, care was taken to avoid twisting it. He then, with very great ease, pushed the spigot, with the ring upon it, into the socket, and the operation of making the joint was completed. When the spigot was pushed into the socket, the ring rolled along the pipe until the end of the spigot came home, the ring remaining fixed about the middle of the depth of the socket. If the ring had been twisted it would not have rolled in regularly, and would not therefore have been equally compressed.

* Of the firm of Messrs. Mackintosh and Co.

The facility with which the joint was made was very remarkable, the whole operation being completed in a minute, and in this respect the saving of time and labour, as compared with that required for lead or wood joints, is very considerable.

Mr. Brockedon wished me to try experiments upon this new joint, and make such investigations as I might consider necessary to satisfy myself of its value with a view to its general introduction. This I have done, and the result is very favourable.

The facts to be ascertained were, the durability of the material as compared with materials usually employed, its capability of resisting pressure, and the cost of making the joint, all equally important in a commercial point of view.

First. As regards its durability. I consider it a question that should be determined by chemists; and the report of Mr. Arthur Aikin, given at the end of this report, satisfied me of its superiority, in this respect, to lead or wood; and I believe practical experience, since the introduction of vaulcanised India-rubber, fully corroborates these opinions. As, however, the question of durability cannot be practically determined in a few years, and as it is most important, in a commercial point of view, that the material used for joints should be very durable; so, the time since the introduction of this material being comparatively short, I felt it was necessary to have the opinions of those who were well qualified to give them upon the probable durability of the material, as compared with others now employed. One fact is well worthy of notice, as regards the action of the products of coal upon this material, especially as they appear to be the only liquids that affect it. Naphtha, it appears, will *dissolve* simple or unvulcanised caoutchouc, but only *swells* it when vulcanised; and thus the effect, which for some purposes would be injurious, for this purpose is advantageous, as the effect of it is to make the joint tighter.

As a general principle, there can be no doubt that, *cæteris paribus*, the more elastic the material for a joint is the better, as the friction of an elastic body pressing against the sides of the pipes is much greater than that of an inelastic body; and hence the resistance to pressure, or force exerted to displace it, must be much greater. In a joint made with lead, the resistance to the pressure is owing to the melted lead filling up any irregularities in the surfaces of the spigot and socket, thus forming a key, and also to the compression of the lead, effected in "setting up." Now, this effect does not extend above a quarter of an inch beyond the external face of the joint, and, therefore, it is most important that this operation should be carefully performed. Great force is employed in "setting up;" it is, therefore, necessary to have the thickness of the sockets greater than the rest of the pipe, to prevent its splitting during this operation. Again, in a wood joint, the operation of driving in the wooden wedge causes it to be compressed; thus, the wedge which, before driving, is from half an inch to five-eighths of an inch in thickness, is compressed to the thickness of three-eighths of an inch when in its place, this compressed part being about 1 inch in depth of the socket. Now, in this operation, although the wedge may be driven in so tight that neither air nor water can pass through, and so far this cause of decay avoided, nevertheless, the fibres of the wood are injured by the operation of driving, and its elasticity consequently much impaired. In this case also it is necessary to have the sockets made strong to resist the force applied in driving in the wedges. With a body as elastic as the vulcanised India-rubber, however, such force is not necessary, the material cannot be forced or driven in with a hammer, it is merely rolled in; and the ring which, before compression, is round, when in its place takes the form of a flat belt instead of a circular ring. Thus, supposing the thickness of a ring to be three-eighths of an inch in diameter before compression, when rolled into the socket, with a space of one-fourth of an inch between the spigot and socket, it becomes a belt of $\frac{8}{32} \times \frac{16\frac{1}{2}}{32}$; or the depth of the belt is more than double its thickness; and this elastic flat belt of rubber, which has naturally an excessive tendency to resist sliding, is constantly endeavouring to resume its circular form, and hence the great friction exerted on the sides of the pipes, while in this compressed state.

[Here follows an account of seventeen different experiments made by Mr. Wicksteed to test the efficiency of these joints.]

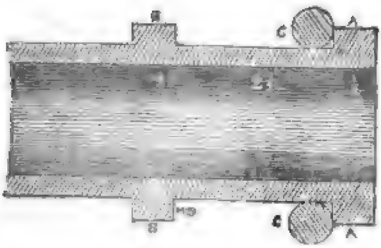
The time occupied in these trials has been above five months, and I am now enabled to speak very confidently of the value of the new joints.

It appears that, for a 4 inch joint, the space between the spigot and socket being one-fourth of an inch all round, the vulcanised India-rubber ring should weigh $1\frac{1}{4}$ ounce, and for a 12 inch ring; the space between the spigot and socket being the same, viz., one-fourth of an inch, the weight of the ring should be $5\frac{1}{4}$ ounces.

The spigot and socket ends of pipes to suit the vulcanised India-rubber rings should be formed as follows:—The depth of the socket for all pipes up to 12 inch, which

is the largest I have experimented upon, should be 3½ inches; the thickness of the joint or space between the outside of the spigot and inside the socket, should be one-fourth of an inch. There will be no occasion for extra strength in the sockets, as they are not exposed to any blows or to the force of the wedge in making the joint, as in lead and wood joints. The spigot should have a square head or belt $\frac{3}{16}$ths of an inch thick, and half an inch deep, cast on the end, then a clear space of 2½ inches, and then another belt of the same dimensions, thus :—

Section of spigot-end of pipe.



A A, end fillet or belt.
B B, upper fillet.
C C, section of vulcanised rubber ring.

This will allow a play of $\frac{1}{16}$th of an inch all round, and the upper belt will effectually prevent the joint blowing out; should there be any slight deficiency of thickness in the India-rubber ring, or should the ring be put on the spigot carelessly, so as not to roll regularly; this, however, can scarcely ever happen, as the fillet at the end of the spigot will be a guide to the workman, and very much facilitate the fixing of the ring properly.

I have calculated the weight and cost of 100 rings of various sizes, which will be the number required for 300 yards of pipes, as follows :—

		Weight. lbs.	oz.	Per lb.	£	s.	d.
3	inch	7	0	At 5s.*	1	15	0
4	,,	9	6	..	2	6	10½
5	,,	12	5	..	3	1	6¾
6	,,	15	4	..	3	16	3
7	,,	18	3	..	4	10	11¼
8	,,	22	2	..	5	5	7½
9	,,	24	1	..	6	0	3¾
10	,,	27	0	..	6	15	0
11	,,	29	15	..	7	9	8¼
12	,,	32	14	..	8	4	4½

* The wholesale price; for small quantities the price is 6s. per lb.

To make a comparison between the cost of the India-rubber joints, and lead or wood joints, I have in the following statement included the *material*, the *labour in making the joint*, and the *excavation*, and *filling in of the trench* only, but including 10 per cent. profit :—

	Lead per yd. run. s.	d.	Wood per yd. run. s.	d.	Vulcanised India-rubber per yd. run. s.	d.	Vulcanised India-rubber cheaper than lead.	Vulcanised India-rubber cheaper than lead.
4 inch		$6\frac{6}{16}$		$4\frac{6}{16}$		$3\frac{3}{16}$	100 per cent.	42 per cent.
12 inch........	1	7		11		$9\frac{8}{16}$	91	11
3, 4, 5, 6, 7, 8, 9, 10, 11, 12, in. one yard of each	10	0	6	2	5	2	93	19

Taking one yard of each sized pipe, from 3 inches to 12 inches inclusive, and in addition to the above, adding the average cost of *carting the pipes to the trench*, *removing surplus earth*, *repairing drains*, *lead pipes*, *&c.*, *and all other charges and risks*, *and guarantee for twelve months*, EXCEPTING *the charges of the Commissioners of Roads or Streets for paving*, *&c.*, the cost will be as follows :—

Lead.	Wood.	India-rubber.	India-rubber cheaper than lead.	India-rubber cheaper than wood.
23s. 10d.	20s. 6d.	19s. 6d.	22 per cent.	5 per cent.

The prices given may vary according to the locality and nature of the ground, but, I believe, will be found in every case very moderate for good and sound work. Where there is rock, or paved or Macadamised roads to be excavated for the trench, the saving in laying the joints with India-rubber rings will be very great, as the extra excavation required round the joint for lead, cement, or wood joints, to afford sufficient room for the joint maker to work all round the joint, will not be required for the India-rubber joints; and hence the saving in excavating through rock, and excavating or taking up and *renewing* the paved and Macadamised roads, will be considerable.

When the wood joints are used (and they have been used very extensively in the East London district for the last sixteen or seventeen years, and found to answer remarkably well), it is necessary to expose the joints to the pressure of water they are in-

tended to bear, before the ground is filled in, to be certain that the joints are tight; hence, unless in connection with mains already charged, they cannot be employed, for the expense of working a force pump to fill every length of pipe before it is covered, swallows up all the saving that, under other and more favourable circumstances, is effected; so that for new towns, or places where there are no charged mains already in existence, they cannot be used; and for gas pipes they are not at all applicable.

An objection was made many years ago to the wooden joints; that where the pipes had to be much curved, it would not be safe to make an unequal joint thick on one side and thin on the other, while with lead this might be safely done by a clever joint-maker. The same objection may be made to the proposed joint, on account of the belts preventing a greater play than $\frac{1}{16}$th of an inch in the socket,—the answer given in the first instance will do in the second, should it be made; viz., that the number of joints required to be so made, formed an inconsiderable per centage upon the whole number made, and, therefore, formed no sufficient objection to the *general* use of a cheaper joint.

As regards its applicability to gas pipes, I have some hesitation in giving a strong opinion; but as Mr. Aikin's Report proves that it is a durable material, and is not injuriously affected by the products of coal gas which collect in the pipes; and as it appears from my experiments that the joint can stand an enormous pressure, I think it may, probably, be found the *best* material that could be used for a gas joint. I believe it will be admitted, that with the materials ordinarily employed in joining gas pipes, it is difficult to fill the joint so thoroughly as to prevent the escape of gas, which the colour of the earth near the joints of gas pipes will prove; and although a lead or wood joint may be made capable of withstanding great pressure, and so as to prevent *water* leaking through, nevertheless *gas* will escape through. Reasoning upon the matter would, therefore, lead to the conclusion, that if a very elastic body is used, pressing with great force on all the surfaces of the iron in contact with it, so as to fill every space, there is much greater certainty of forming a tight joint than with a non-elastic substance, where the density of the material is all that prevents the escape of *gas;* it must be borne in mind that the India-rubber is impervious, and can never be liable to have fissures in it, or pores through it, which may be the case with lead, cement, or wood, if not perfectly made,—not so large as to allow a liquid to pass through, but sufficiently so to allow gas to pass through.

As regards pipes made of earthenware or glass, or other brittle material, which would be broken, if it were attempted to make joints of lead or wood, to withstand a pressure of water, this material is very applicable, as no force is applied in making the joint that would in the slightest degree tend to split or break the socket of the pipe. This joint removes the only mechanical objection that I believe exists to the use of these materials; but the chances of breakage when laid, and the cost of the pipes when so joined (increased by the shortness of the lengths of the pipes requiring a greater number of joints), are questions to be considered by those who propose using such materials. It appears that none of the products of the sewers would injuriously affect the vulcanized India-rubber. The improvement in making the India-rubber rings since I received the first for trial is very great. The first *set* varied in thickness and weight very much; the last are as regular in thickness, as can be proved by the weights of several of the same size being as nearly as possible the same. This is most important, as a variation in weight, which is the same as a variation in thickness, would prevent the certainty of tightness of the joint. I have, nevertheless, in the weights given in the Table, allowed as an extra weight as a precaution.

In conclusion, I beg leave to say, that it appears that for strength, durability, resistance to pressure, and for the closeness of the joint preventing the escape of gases, this material is better suited than the ordinary materials in use; and, that the cost of the joints is less than the cost of those in ordinary use for iron pipes.

REPORT OF ARTHUR AIKIN, ESQ., F.L.S., ETC.

Will Rings of Vulcanized Caoutchouc, when used as Fastenings of Cast-Iron Pipes, retain their Elasticity, and what will be their probable Durability?

The resilient spring of vulcanized caoutchouc is far more complete than that of caoutchouc not vulcanized. In other words, the former is far less liable to *tire* than the latter. Caoutchouc is vulcanized by combination with a certain small proportion of sulphur. As long, therefore, as caoutchouc remains vulcanized, that is, as long as it retains its sulphur, it may be expected to retain those qualities by which it is characterized. But iron has a strong attraction for sulphur. Is it not, therefore, probable that vulcanized caoutchouc remaining long in contact with iron, may give up its sulphur to this latter, and thus be reduced to the state of common caoutchouc?

I see no satisfactory way of bringing this question to the test of experiment, as both cast-iron and common bar not unfrequently contain sulphur in various proportions. The rings of vulcanized caoutchouc that I have seen taken out of iron pipes return to their original form as soon as the nip or strong compression to which they were subject while in the pipes has been relieved; and they are stained externally by a little oxide of iron rubbed off from the inner surface of the pipe, in consequence of the strong friction and compression to which they are exposed in the act of inserting one pipe into the other. Beyond this merely superficial attrition, I do not think that any sensible action would take place between the ring and the iron, even for a very long time, at common temperatures.

If the pipes are intended for the conveyance of water, the exposure of the projecting edge of the ring to this liquid at common temperatures cannot possibly have any injurious effect; for I have boiled vulcanized as well as common caoutchouc for an hour in water at 300°, and the pieces, when they have become dry, have shown no diminution of their respective degrees of elasticity. If the pipes are to be employed in conveying coal gas, the original question becomes complicated with the consideration, how far the volatile products of the distillation of coal are capable of acting on vulcanized caoutchouc? The principal matters driven off from coal during its distillation are carburetted hydrogen and olefiant gas, sulphuretted hydrogen, ammonia, tar. I believe, that in a very short time the projecting edges of the vulcanized rings would be covered with a thin layer of tar, which would effectually prevent their contact with the other matters, even assuming these latter to have any action on vulcanized caoutchouc. Naphtha, the product of the rectification of coal tar, is capable of dissolving caoutchouc; but the only effect which it has, even when boiling hot, on *vulcanized* caoutchouc, is to cause it to swell. If the crude tar should have any such effect (which I doubt), the consequence would be, that the projecting edge of the ring would swell, and thus render still more effectual a fastening which was sufficiently so before. The strongest liquid ammonia, as I know by experiment, has no solvent action whatever, even on common caoutchouc, by digesting in it for several months. Sulphuretted hydrogen has no sensible effect on common caoutchouc immersed in it for some days. If by long-continued action on vulcanized caoutchouc, any sulphur was taken up, no injury to the ring would result from this; for vulcanized caoutchouc may contain a great excess of sulphur, without at all impairing its elasticity and other valuable properties.

With regard to the durability of vulcanized caoutchouc compared with that of wood or lead, which, I believe are the only substances at present used in joining iron pipes, the following circumstances must be taken into consideration.

The compression and violence which wood undergoes in the act of being driven in, will more or less damage its texture, and weaken the lateral cohesion of its fibres. Caoutchouc being without visible pores, and being of a perfectly uniform consistence, and possessed of great elasticity, will not only exclude air and moisture from the space which it occupies, but is scarcely susceptible of mechanical injury, even from the strongest compression.

Lead is no more porous than caoutchouc, but being almost totally inelastic, will, on this account, be a less effectual preventive of leakage. Some galvanic action will probably take place between the lead and iron tending to oxidise this latter; and, when galvanic action has ceased, from the interposition of a layer of oxide of iron between the two metallic surfaces, the lead itself will become oxidised superficially, from the combined effect of air and moisture.

I do not, therefore, see any reason to doubt that rings of vulcanized caoutchouc, when used as a fastening of iron pipes employed in the conveyance of water or coal gas, would be, at least, as durable as the best of the methods now practised, and probably more secure from leakage.

TELESCOPES.

Sir,—Your Magazine being the best I am acquainted with to obtain information on subjects of practical science, I am induced, as an original subscriber to it, to trouble your correspondents with the following queries:—

1. Is there any description of Lord Rosse's great telescope, with engravings, published?

2. What is the diameter of the object glass of the largest refracting telescope now in use in the country; and has any description of it been published?

I may mention, that in respect to the first question I have read the account in *Chambers' Journal* of the Parsonstown telescope; and with respect to the second question, I have an account of Mr. Cooper's telescope at Mackree Castle. Yours.

A MONTHLY SUBSCRIBER.

December 16, 1848.

ENGLISH SPECIFICATIONS ENROLLED DURING THE WEEK ENDING DEC. 23.

JAMES ROOSE, Darlaston, Staffordshire, tube manufacturer, and WILLIAM HADEN RICHARDSON, the younger. *For improvements in the manufacture of tubing.* Patent dated June 15, 1848; specification enrolled December 16, 1848.

This invention consists in rolling the tubes or flues of locomotives out of thick short cast metal tubes composed of copper or of any alloy of that metal, in the following manner:—The cast metal tube is placed upon a steel mandril, and passed through one or more pairs of suitably grooved rollers of progressively decreasing diameter, until the thickness of the tube is decreased, and its length increased sufficiently. The tube is supported and kept steady during the process of rolling by rollers placed in front of the grooved rollers. The mandril is afterwards withdrawn by a draw-bench.

The patentees make no claim.

GEORGE EMMOTT, Oldham, Lancaster, C.E. *For certain improvements in the manufacture of fuel, and in the construction and arrangement of furnaces, flues, boilers, ovens, and retorts, having for their object the economical application of caloric, the manufacture of gas for illumination, and the consumption of smoke and other gaseous products.* Patent dated June 16, 1848; specification enrolled December 16, 1848. *Claims.*—

The manufacture of fuel by the carbonization of coal in the ovens or retorts, which may be wholly or partially closed at pleasure.

The application of the gaseous products evolved to illumination, and to the heating of boilers, and of the residuum to useful purposes.

The combination of ovens and retorts with a system of furnace.

The introduction of the evolved gas behind the fire bars of the furnace.

The arrangements for consuming the smoke and other gaseous products.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Joseph Eccles, of Moorgate Fold Mill, near Blackburn, Lancaster, cotton spinner, and James Bradshaw and William Bradshaw, of the same place, watchmakers, for certain improvements in, and applicable to looms, for weaving various descriptions of plain and ornamental textile fabrics. December 15; six months.

William Wharton, superintendent of the carriage department of the London and North Western Railway Station, Euston-square, for certain improvements in the construction of vehicles used on railways, or on other roads and ways. December 15; six months.

Henry Walker, of Gresham-street, London, needle manufacturer, for certain improvements in the process or processes of manufacturing needles. December 16; six months.

William Wild, of Salford, Lancaster, moulder, for certain improvements in rotary steam engines. December 16; six months.

Alfred Vincent Newton, of Chancery-lane, for improvements in casting printing types and other similar raised surfaces, and also in casting quadrats and spaces. (Being a communication.) December 16; six months.

William Clay, of Clifton Lodge, Cumberland, engineer, for certain improvements in machinery for rolling iron or other metals, parts of which improvements are applicable to other machinery in which cylinders or rollers are used. December 16; six months.

Joseph Deeley, of Newport, Monmouth, engineer, for improvements in ovens and furnaces. December 16; six months.

Edward Smith, of Kentish Town, window blind manufacturer, for improvemdnts in window blinds, and in springs applicable to window blinds, doors, and other like purposes. December 16; six months.

William Major, of Culchett, near Leigh, Lancaster, manufacturer, for improvements in looms for weaving certain descriptions of cloths. December 16; six months.

John Cartwright, of Sheffield, York, tool maker, for an improved brace for the use of carpenters and others. December 16; six months.

John Clinton, of Greek-street, Soho-square, professor of music, for improvements in flutes. December 16; six months.

John Travis and John M'Innes, of Liverpool, lard refiners, for improvements in packing lard. December 16; six months.

William Curtain, of Retreat-place, Homerton, gentleman, for certain improvements in the method of manufacturing Brussels tapestry, Turkey, and velvet, or cut pile carpets and velvets, silks, linen, mixed cloths, and rugs of all descriptions, by which method less warp is required, and perfect and regular figures or patterns are produced. December 16; six months.

Thomas Dickins, of Middleton, Lancaster, silk manufacturer, for certain improvements in machinery or apparatus for warping and beaming yarns or threads composed of silk or other fibrous materials. December 21; six months.

William Wilkinson, of Dudley, Worcester, manufacturer, for a certain improvement or certain improvements in the construction and manufacture of vices. December 21; six months.

James Henry Staple Wildsmith, of the City-road, London, experimental chemist, for improvements in the purification of naphtha (called wood spirit and hydrated oxide of Methyte), pyroligneous acid, and eupion, and certain other products of the destructive distillation of wood, peat, and certain other vegetable matters, and of acetate of lime and shale, and in the purification of coal tar and mineral naphtha, likewise spirit being the products of fermentation. December 21; six months.

Charles Augustus Hohn, of King William-street, civil engineer, for improvements in printing. December 21; six months.

John Penn, of Greenwich, Kent, engineer, for certain improvements in steam engines. December 21; six months.

Pierre Armand Le Comte de Fontainemoreau, of South-street, Finsbury, London, for certain hygienic apparatus and processes for preventing and curing chronical and other affections, and to prevent or stop certain epidemic diseases. (being a communication.) December 21; six months.

William Baker, of Edgbaston, near Birmingham, civil engineer, and John Ramsbottom, of Longsight, near Manchester, engineer, for improvements in the construction of railway wheels, and in railway turn-tables, which latter improvements are appli-

cable to certain shafts or axles driven by steam or other motive power. December 21; six months.

William Riddle, of White Friar-street, London, gentleman, for improvements in the construction of ever-pointed pencils, writing and drawing instruments, and in inkstands or inkholders. December 21; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Dec. 15	1701	McLardy and Lewis ...	Salford	Flyer top for preparing spinning cotton, and other fibrous substances.
,,	1702	Robert Sargison	Wisbeach	Straw-shaking machine, for separating the corn from pulse.
16	1703	Timothy Adams Jordan,	Old-street Road, London	Tyre.
,,	1704	Stephen Barton	Bristol	An open or close carriage with a round cornered glass front
,,	1705	Myer Myers	Birmingham............	Penholder.
18	1706	A. Grant Brothers	Clements-court, Cheapside	The Beaufort collar.
,,	1707	Joseph Fenn	Newgate-street	Double-headed cylinder wrench.
19	1708	Wm. Hen. Neuber.......	Long-acre	Placard holder.
,,	1709	Thomas Davy Durant...	Lindfield, Sussex	Sound-board receiver for pianofortes.
20	1710	Jos. Sam. Hodge.........	New Oxford-street............	Safety-pocket or receptacle.
,,	1711	John Hitchen	Tarporley, Chester............	Vent-peg.

Advertisements.

NOTICES TO CORRESPONDENTS.

A stamped edition of the Mechanics' Magazine, to go by post, price 4d., is published every Friday, at 4 o'clock, p.m., precisely, and contains the Claims of all the Specifications Enrolled, New Patents sealed, and Articles of Utility registered during each week, up to the time of going to press. Subscriptions to be paid in advance. Per annum 17s. 4d., half-yearly 8s. 8d., quarterly 4s. 4d. Post-office Orders to be made payable at the Strand Office, to Joseph Clinton Robertson, of 166, Fleet-street.

CONTENTS OF THIS NUMBER.

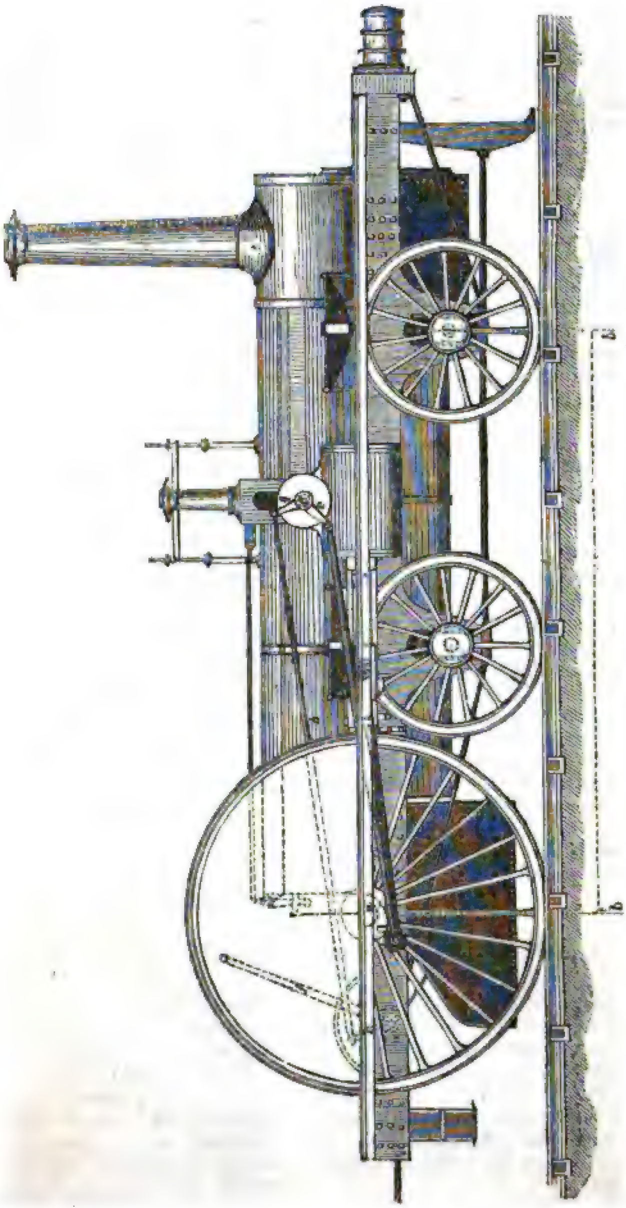
LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co. Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1325.] SATURDAY, DECEMBER 30, 1848. [Price 3*d*., Stamped, 4*d*.

Edited by J. C. Robertson, 166, Fleet-street.



MR. W. B. JOHNSON'S PATENT LOCOMOTIVE ENGINE.

MR. W. B. JOHNSON'S PATENT LOCOMOTIVE ENGINE.

The prefixed engraving represents a side-elevation of a narrow gauge locomotive engine, in which figure my improvements relating to the position of the driving axle, form of fire-box, and valve gearing for admitting steam into and out of the steam cylinders, and reversing the motion of the engines are exhibited.

The driving axle, *a*, instead of being placed as usual under the cylindrical part of the boiler, or at the extreme ends of the engine, is placed over the top of the fire-box. This position of the driving axle possesses the following advantages:

1st. The admitting of driving wheels of 8 feet diameter, or more, to be applied on the narrow gauge.

2nd. An increased steadiness of engine in working, by bringing the centre of weight considerably nearer to the line of road.

3rd. The extreme centres, *b b*, of the wheels are also lessened, by bringing the driving axle, more forward than the end of the fire-box.

4th. The increased heating surface obtained by having tubes longer than can be used in ordinary engines having the same length of extreme centres.

5th. The increased traction of the driving wheels upon the line of road, having a greater proportion of the weight of the engine upon them than can safely be applied to engines, having driving wheels in the centre of the engine.

And 6th. The oscillating motion of engines running at high speeds is lessened—a greater proportion of the weight of the engine being thrown upon the extreme wheels than is the case with driving wheels placed in the centre of the engine.

The form of fire-box here represented possesses the advantages of a great saving in material and workmanship, and of being such as to render the upper portion, "hitherto the weakest and least capable of sustaining the required pressure of steam," as strong and as firm as any other part of the fire-box or boiler.

The apparatus for admitting steam into and out of the cylinders, and reversing the motion of the engines, is worked from the crank pin, *o*, and through the coupling rod, *d*, and crank, *e*, it communicates to the valve-shaft, *f*, a rotary motion simultaneously with the driving-axle, *a*; *g* is the reversing lever to which the required motion is given by the engine-man through the intervention of the coupling rod, *h*, and levers, *i*, *j*. The advantages of this construction of apparatus for effecting the reversing of engines, and admitting steam into and out of the steam cylinders, are 1st. Economy in construction; an extremely simple arrangement of machinery being substituted for the four eccentrics, rods, levers, and other complicated apparatus, now used for effecting the same results. 2nd. Economy in working; the parts being few in number, and not liable to the same disarrangements as the valve gearing now in use. 3rd. Ease of access to all the parts; for cleaning and repairing, and also for superintendence whilst at work. And, 4th. Economy in fuel, the exhaust side of the piston being open to the action of the atmosphere for a greater portion of the length of the stroke than can possibly be obtained by the slide-valve gearing.

W. B. Johnson.
Engineer.

Liverpool, December 5, 1848.

GEOMETRICAL AND ALGEBRAICAL STUDIES—OBSERVATIONS ON THE ARTICLE OF "EX-REVIEWER."

Sir,—As it appears by your "Note," (p. 417) that the article by "Ex-Reviewer," reached you nearly at the same time as my manuscript, it is obvious that his remarks do not, and were not intended to, apply to anything which my papers contained on the subject. There are only two things in his article to which I shall allude.

1st. The relative merits of Geometrical and Algebraical studies.

2nd. The opinion expressed as to the "inductive" nature of the proofs of Algebraical Theorems.

With regard to the first point—I have expressed my opinion partially in a former paper, and I believe the only difference in our views is merely as to the extent to which algebraical or symbolical processes can be made useful as a "discipline of the intellect." I have allowed quite as high a place to geometry,

I think, as your "Ex-Reviewer" would claim himself; but I believe that our chief difference consists, in an unwillingness on his part, to allow that algebraical processes may be made an exercise of the reasoning powers, to the extent which I have claimed. As practised by schoolboys, and most persons in fact, algebra really cannot be said to afford any exercise at all, comparable with that which geometry does. But this is, in reality, owing to the difficulty of the subject itself, the very endeavours to conquer which, however, supply to the more advanced student an exercise and a discipline of a far higher character and severer nature, than anything geometry affords. I include, of course, every possible method of geometrical research, even to the very highest attempts at the discovery of general methods (either as restorations of what we may suppose were known to the Greeks, &c., or entirely new ones). And I make this ascertion with a full knowledge of the very high position which your "Ex-Reviewer" holds in this department of mathematics. If the question between us, indeed, could be decided by the relative acquaintance with geometrical methods, it would be my place at once to submit; but I believe it will not be difficult to justify the above assertion from the very nature of the two subjects themselves which we are comparing, altogether irrespectively of *degrees* of knowledge in each. For, geometry is by its very nature restricted to one single class of ideas, and the very clearness and absence of ambiguity or indistinctness in those ideas, renders impossible, any exercise or discipline of that kind, which the study of more general methods necessarily calls forth. The doubts which exist at this day, and which have always existed, even in the minds of some of the first mathematicians, as to the real nature and validity of algebraical processes, are the strongest evidence of what I have asserted. The efforts of mind which are necessary to make out with any degree of clearness and satisfaction *what* the real nature of these processes *is*, constitute the severest intellectual discipline which can be found.

It is in truth of quite a different kind from that brought into play by geometry —so far as any one exercise of the reasoning powers *can* be different from another, and cannot be entered upon without that previous discipline which geometry so admirably supplies. The opinion which is so prevalent, even at the present day, and amongst very many mathematicians, of the superiority of geometrical studies as an exercise of reasoning, is founded altogether on a very unjust comparison— the comparison of geometry with the "algebra" of the schoolboy—the mere *mechanical* algebra as it may be called.

I remember meeting with an allusion to this subject in a place where one would little expect it—in Chalmers's "Christian and Economic Polity of a Nation." "I remember that more than twenty years ago, when I attended the lectures of Professor Robison, among all the felicities of thought and of illustration in which he abounded, there was none which delighted me more at the time, or which has clung to me more tenaciously ever since, than one that he uttered when in the act of drawing a parallel between those two great branches of mathematical science, geometry and algebra. His taste and his preference were altogether on the side of geometry; and that, because in the business of its demonstrations, the thinking principle is at all times in close exercise and contact with the quantities themselves. The lines and the angles, and the surfaces, are never out of the mind's eye during the whole of the investigating process; and whether you know much of the mathematics or not, you can, at least, conceive how much more freshly and deliciously the understanding is regaled, when thus set to work immediately, and without the intervention of any artificial medium, on the realities of the question. Now, the same does not hold of algebra. The quantities are not in the eye of the mind, because removed and hidden therefrom under the veil of an arbitrary nomenclature. It is not with the things, but with the terms expressive of the things, that the mind has immediately to do. Instead of the understanding being employed on actual truths, or actual relations, it is rather the hand which is employed in shifting and shuffling among the hieroglyphics of a formula. It is thus that algebra, however powerful as an instrument of research, does not afford so satisfying an intellectual repast to its disciples as does geometry. In-

somuch, that the late Dr. Gregory, who seems to have regarded with mortal aversion the very physiognomy of an algebraical page, came forth with the memorable saying, that "algebra was an invention for enabling the mind to reason without thinking." And Professor Robison, than whom a truer philosophic spirit never graced the University of Edinburgh, has given us a deliverance upon this subject which is equally memorable; that he liked geometry better than algebra, because in the former the *ipsa corpora* of the question were present to the mind, and in the latter they were not present to it."—(Works, vol. xvi., page 150, &c.)

A "*memorable deliverance*" indeed!

Dr. Chalmers has made use of this same comparison in another work of his (vol. xxi., page 357), to illustrate the relation between statistics and political economy:

"The statistics which furnish a measure for the intensity or the regularity of certain moral forces that operate and are of influence in human affairs, may at length give to certain moral and economical subjects a near approximation to the exactitude and certainty of mathematics. This consideration, if well weighed, may perhaps reconcile and satisfy those gentlemen of the physical departments, who felt a difficulty in admitting one statistical section within the scheme of the British Association. Not that the essential distinction between the moral and the mathematical can ever be obliterated, any more than in mathematics itself, we can obliterate the essential distinction between geometry and algebra. It is now forty years since I heard Professor Robison of Edinburgh, all whose tastes and preference were on the side of geometry, state, and felicitously state, that so long as the mind was engaged in it, it was in more direct and immediate contact with what he expressively termed the *ipsa corpora* of the subject—whereas, in algebra, while he did all homage to the latter as being the more powerful instrument of research and discovery, after that lines were commuted to symbols, the thinking principle had no more to do with the real and original elements of the question; but losing sight of these, had only to do with certain artificial and representative characters in the management and transformation of which it was altogether occupied. Now certain it is, that they are only the observers of life and character who hold sensible commerce with the *ipsa corpora* of our department—the principles or the phenomena of human nature; and that the mere statists are only taken up with the resulting numbers which come forth of the working of these in communities of assembled men. Nevertheless, in the tables of the statist, as well as in the formulæ of the analyst, we may have correct exhibition of objective realities in the external world—a rigorous expression, in the one case, of things in the world of motion and inanimate matter—an accurate registration in the other, of things in the region of human society."

Now the truth of the matter is simply this:—

That a clear and vivid impression of geometrical truth which is so satisfactory to all minds (Robison was just like every one else in this respect,) is produced by the very nature of the subject itself, and by the constant presence of the diagrams, acting as an unceasing "refresher" to the memory and preventing all possibility of confusion.

But in other subjects to which algebra is usually applied,—mechanics, for example—it is impossible, from the very nature of the subject itself, to bring the mind at every step into that actual "contact" with the *ipsa corpora* which geometrical diagrams do. Not only are the ideas, on which mechanical investigations are founded, more difficult in themselves to seize—but when they are seized, we have no means of representing them and calling the attention to them, *except by artificial signs*. The figures in geometry are *not artificial* signs. Not only is the reasoning process itself much easier in geometry—it is *facilitated* by means which do not exist in other subjects. Nothing then can be more absurd, than to attribute to algebra itself, the difficulties and obscurities with which it has nothing on earth to do—which belong in fact to the sciences to which algebra is applied, and which would be almost infinitely greater were it not for the assistance algebra affords.

Professor Robison, very probably, was thinking of his dynamical studies and of the great continental works by Euler, Lagrange, &c. Suppose these writers had used geometrical diagrams (as Newton did) instead of letters, would this have facilitated the study? The difference between such a method and theirs would be the same as the difference be-

tween a work on the same subject in two different languages. The ideas are the same though expressed by different words or signs.

The reasoning in geometry itself—in Euclid's Elements, is carried on by means of symbols—namely, the words of the English or some other language. The evidence and clearness of the demonstrations, however, is owing to the nature of the subject itself. Professor Robison might therefore as well have said, that in reading an English edition of Euclid the mind was not "in contact" with the truths themselves—but was employed in the "management of certain artificial representatives of those truths—viz., the words of the English language." The fact that our minds are *not* so taken up and employed, is owing to our great familiarity with these signs or words of our native language. Now, a similar familiarity with the algebraical signs, may be obtained, and is obtained by the practised mathematician, and to him every symbol is just as expressive as the words of our ordinary language are to the common reader—and the reasoning carried on by means of the one as satisfactory as that carried on by means of the other.

The comparison of Dr. Chalmers, however, is a very instructive one. Statistical details cannot supply the place of personal knowledge and familiarity with the circumstances to which they apply. No more can algebraic formulæ supply the place of internal familiarity with the ideas of the subject of which they are merely the external representatives. A man must have clear common sense notions of force and its various "measures," &c., before analytical mechanics can be to him anything more than a table of statistics to a man who knows nothing of what the statistics refer to. To a person studying the effect of the Navigation Laws, a single table showing the number of ships which entered a certain port in two given years, might be significant in the highest degree—might prove, in fact, with all the force of a rigid demonstration, the truth or falsehood of some controverted doctrine. To another man, unacquainted with the subject, it would speak nothing, and prove nothing. The consideration of this table would bring the former reader at once "into contact with the realities of the question," just as well as an algebraical formula might bring the mathematician into contact with the realities of the planetary motions.

The fact, that all reasoning is a purely mental process,—and both the words of ordinary language and the symbols of algebra are merely contrivances for exciting the same ideas and the same train of thought in others, or of re-exciting it in our own minds,—though obvious as anything can be, is really very much overlooked and forgotten. The words used by Euclid, can no more bring the mind into contact with the truths of geometry, than the symbols of algebra can. But owing to the greater familiarity of most persons with common language, their minds are *much sooner and more easily* brought into this "contact" by it than by algebraical language.

It is true, however, that there is very frequently *an appearance* of arriving at new truths through the medium of algebraical operations, without the exercise of the reasoning faculty—and as it were, by the mere mechanical management of the formulæ. In reading a page of algebraical deductions, there is nothing in the symbols themselves which compels the mind into an exertion of its reasoning power. One truth is put as it were into this algebraical machine to begin with, and there comes out a *new* truth as the result of putting this machine into motion.

But in reality each step in the algebraical process is merely the external index of a purely mental process—just in any argument carried on by means of the symbols of ordinary language.

The one grand point, from which all the phenomena, both of ordinary language and algebraic language, ought to be constantly viewed consists in the clear and distinct apprehension that they are nothing more than *media of communication* from mind to mind. Like the wires of an electric telegraph, their function is simply that of *transmission*. And as in the wires of a telegraph, a defect in their construction might lead to misapprehension and ambiguity—so it may be in language—common and algebraic. The comparative advantages of different media of communication is a subject which may give rise to much interesting but intricate discussion. For instance, the gestures by which the deaf

and dumb endeavour to convey their ideas, is one medium which answers the purpose partially, but in a very inferior degree to our ordinary speech. The comparison between speech and writing presents greater difficulties; but on the whole, the latter medium appears to be inferior to the former, as not possessing the power which the intonation of the voice affords. Again, in speaking, several media of communication are combined. The gestures which so naturally accompany our words and the look, aid very much in the quick and accurate transmission of ideas from one mind to another.

A great deal depends, too, on the *rapidity* with which ideas can be brought together; for to perceive clearly their connection requires that they be contemplated in immediate succession. Now, in reading, it necessarily takes some time to effect this approximation of ideas. After the mind has seized the one idea, it has to travel a long way before it gets up with the second. There is, in every case, the difficulty, first of getting fast hold of the two ideas, and then of seeing their connection; but the latter difficulty is generally but small. The great imperfection of language is, that from the ambiguity of some words and the total want of accurate usage of others, a reader may be compelled to take up half a dozen meanings one after the other, and trace out the consequences to see which is the true one. The difficulty felt by most mathematical students is often of this kind: for example, in a book on mechanics, the symbol (g) is not to him a distinct representative of any idea. When he has once learnt that it represents a certain number of feet passed over under certain circumstances (v. 2. in a second of time, and after the body has been exposed to the earth's attraction for also one second, and at the end of that second this attraction is rendered of no after effect), most of the reasoning, or rather of the words and algebraic signs which he comes upon, afterwards become clear and intelligible. To take another example: the words "positive pole" and "negative pole" used in works on electricity, with reference to a galvanic battery, present to most beginners no intelligible notion whatever. But these examples are not examples of the imperfections inherent in language itself, but of inaccurate and indefinite usage of it.

Precisely the same *kind* of difficulty, however, often follows from the nature of language itself, and still more often from the loose and vague way in which many words are constantly used by the great mass of people. Now the same source of confusion and error is to be found in the highest departments of mathematical science—for example, from not attaching any definite idea to a symbol used to denote a "function;" by which means it may happen, that theorems and consequences, proved to be true for certain kinds of functions, may be unconsciously transferred to other kinds of which they are not true. A great deal of the very general assertions in what is called "analysis"—as, for instance, that of Lagrange, "that every function of x can be expanded in a certain series," &c., &c., may be traced to this want of a distinct notion of that, concerning which such assertions are made, rather than to any logical error in the subsequent reasoning. One of the commonest errors is to assert as generally true, that which is only true under certain circumstances, and to use a word or symbol in a process of reasoning in such a manner that the final result is supposed to hold for *all* the meanings of which that word or symbol is capable, when in reality the reasoning has only proved it for some one or two of its meanings. A writer, too, may use a word in a strict and definite sense, but his readers, through some association of ideas peculiar to themselves, may have very different notions excited in their minds by this word; and so to some readers, the reasoning may appear clear enough, whilst to others it may seem obscure or wrong.

The subject, however, of the nature and imperfections of language, and of algebra as media of communicating ideas and reasoning, is perhaps hardly in place in these pages. If I can succeed, however, in exciting inquiry amongst any of the readers of this Magazine into the real nature of algebraic processes, and if they are thereby led to satisfactory views, no further excuse will be needed for having introduced the subject.

In concluding these remarks — with reference more particularly to those made by your "Ex-Reviewer"—and in order

that I and your readers may understand how far his views agree with those I have endeavoured to explain, I will put the following question: Does "Ex-Reviewer" admit the logical validity and legitimacy of the reasoning in the following application of the method of the "Separation of Symbols" to the solution of a differential equation? I have framed a simple example of this mode of applying the processes of ordinary algebra to the subject of differentiation and integration, as it is always better to have some definite process in view than to talk about vague generalities. Your "Ex-Reviewer" will thus have an opportunity of expressing his opinion on the legitimacy of such processes, and of thereby showing whether or not he acknowledges the truth of what I have, in the course of the preceding article, asserted with regard to them.

(It may be as well to state here, that the *History* of the recent advances made in this subject, of which, in the commencement I expressed an intention of giving a sketch, has been delayed by want of leisure to finish it, but may probably appear in an early Number of the Magazine.)

$$\frac{d^2y}{dx^2}-\frac{17}{30}\cdot\frac{dy}{dx}-\frac{1}{15}y=4mx^2.$$

$$\therefore\left(\frac{d}{dx}-\frac{2}{3}\right)\left(\frac{d}{dx}+\frac{1}{10}\right)y=4mx^2.$$

$$\therefore\left(\frac{d}{dx}-\frac{2}{3}\right)y=\left(\frac{d}{dx}+\frac{1}{10}\right)^{-1}.4\,mx^2.$$

$$=\varepsilon^{-\frac{1}{10}x}.\left(\frac{d}{dx}\right)^{-1}\left[\varepsilon^{\frac{1}{10}x}.\ 4\,mx^2\right].$$

$$=\varepsilon^{-\frac{1}{10}x}.\left[4\,mx^2.\frac{\varepsilon^{\frac{1}{10}x}}{\frac{1}{10}}-\int\frac{\varepsilon^{\frac{1}{10}x}}{\frac{1}{10}}8\,mx\right]$$

$$=\varepsilon^{-\frac{1}{10}x}.\times10\times4\,mx^2.\,\varepsilon^{\frac{1}{10}x}-\varepsilon^{-\frac{1}{10}x}.-80m.\left[x.\frac{\varepsilon^{\frac{1}{10}x}}{\frac{1}{10}}-\int\frac{\varepsilon^{\frac{1}{10}x}}{\frac{1}{10}}\right]$$

$$=40\,mx^2-80m\,\varepsilon^{-\frac{1}{10}x}.\left[10\,x.\varepsilon^{\frac{1}{10}x}-100\,\varepsilon^{\frac{1}{10}x}\right]$$

$$=40\,mx^2-800\,mx+8000\,m.$$

$$\therefore\ y=\left(\frac{d}{dx}-\frac{2}{3}\right)^{-1}.\ [40.\ mx^2-800\,mx+8000\,m]$$

$$=40.\ \varepsilon^{\frac{2}{3}x}\left(\frac{d}{dx}\right)^{-1}\varepsilon^{-\frac{2}{3}x}.\ (mx^2-20\,mx+200\,m).$$

$$=40.\ \varepsilon^{\frac{2}{3}x}\int\left(mx.^2\varepsilon^{-\frac{2}{3}x}-20\,mx.\ \varepsilon^{-\frac{2}{3}x}+200\,m.\ \varepsilon^{-\frac{2}{3}x}\right).$$

$$=-60\,mx^2-180\,mx-270\,m-800.\,\varepsilon^{\frac{2}{3}x}m\int x\,\varepsilon^{-\frac{2}{3}x}$$

$$+\ 8000\,m\,\varepsilon^{\frac{2}{3}x}\int\varepsilon^{-\frac{2}{3}x}.$$

$$=-60\,mx^2-180\,mx-270\,m-800.\,\varepsilon^{\frac{2}{3}x}.m\left(\frac{x.\,\varepsilon^{-\frac{2}{3}x}}{-\frac{2}{3}}-\frac{9}{4}.\frac{\varepsilon^{-\frac{2}{3}x}}{-\frac{2}{3}}\right)$$

$$-12000\,m.$$

$$=-60\,mx^2+1020\,mx-10470\,m.$$

The accuracy of this solution is easily verified: as thus,

$$y=-60\,mx^2+1020\,mx-10470\,m.$$

$$\therefore\ \frac{1}{15}y=-4\,mx^2+68\,mx-698\,m.$$

$$\frac{dy}{dx}=-120\,mx+1020\,m.$$

$$\therefore \frac{17}{30} \cdot \frac{dy}{dx} = 17\,(-4\,mx + 34\,m)$$

$$\frac{d^2y}{dx^2} = -120\,m.$$

$$\therefore \frac{d^2y}{dx^2} - \frac{17}{30}\,\frac{dy}{dx} - \frac{1}{15}\,y = -120\,m + 68\,mx - 578\,m$$

$$+ 4\,mx^2 - 68\,mx + 698\,m$$

$$= 4\,mx^2$$

For the fourth step in the preceding solution, namely, where ε is introduced, see the first volume of the *Cambridge Mathematical Journal*, p. 25 (or p. 28 of reprint), or Professor De Morgan's "Differential and Integral Calculus," p. 751, or Gregory's Examples. A. H.

TO FIND THE CUBE ROOT OF A LINE BY RULE AND COMPASSES.

Sir,—I hope you may think the accompanying problem worthy of publication in the *Mech. Mag.* My attention was directed to the subject by the following passage in the *Mech. Mag.* for the 7th of last October, p. 355.

"At this time Mr. Mackie, a Roman Catholic priest, published a duplication of the cube, the plausibility of which attracted attention, and, it is said, even obtained the assent of the teachers of Maynooth. Young Murphy, then eighteen years of age, answered this duplication in a pamphlet, entitled, 'Refutation of a Pamphlet written by the Rev. John Mackie, R.C.P., entitled, "A Method of making a Cube double of a Cube, founded on the Principle of Elementary Geometry," wherein his Principles are proved Erroneous, and the required Solution not yet obtained.' By Robert Murphy, Malow. 1824. pp. 20."

I am, Sir, yours, &c.,

J. P. W

To find the Cube Root of a Line by Rule and Compasses.

Fig. 1.

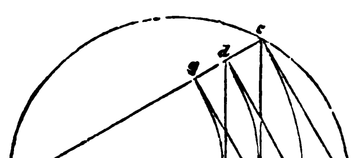


Fig. 2.

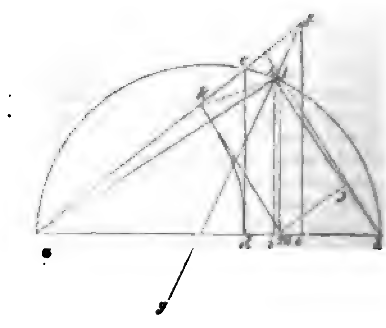


Fig. 1.—If in any right-angled triangle, as *abc*, two other right-angled triangles, *aed*, *afg*, be described in the manner shown by the figure, and *ag* be considered unity, *af* is the cube root of *ab*: for,

$ag = 1 : ad = af :: af : ae = ac = af^2$, and
$ag = 1 : ac = af^2 :: af : ab = af^3$

The problem to be solved, therefore, may be stated in this manner: Any line as *ab*, and the unit *ah*, by which it is measured, being given, to construct upon *ab* a right-angled triangle which shall contain within itself three similar triangles *cbf*, *cfg*, *afg*, the last triangle, *afg*, having the unit *ag* for one of its sides.

Fig. 2.—Let *ab* be the line whose cube root is required, upon it describe the semicircle, *abc*; set off *ad* equal to

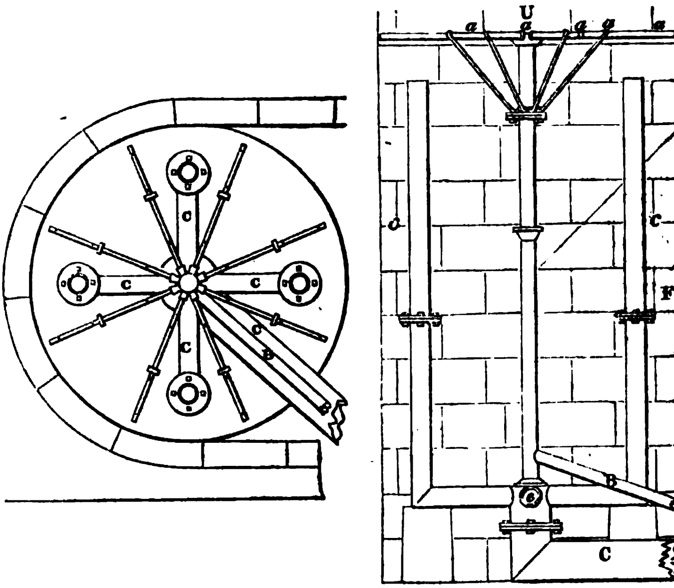
unity, draw *cd* at right angles to *ab*, set off *ae* equal to *ac*, draw *ef* parallel to *cd*, extend *ac* to *f*, bisect the angle *afe* by the line *fg*, cutting the semicircle at *h*, draw *hb* and *hi* parallel to *cd*, draw *ij* at right angles to *hb*, with *ij* for a radius, and the point, *k*, for a centre; describe an arc cutting the semicircle in *l*, draw *lm* parallel to *cd*, and *am* is the cube root of *ab*.

J. P. W.

December 12, 1848.

MR. GURNEY'S PLAN FOR THE VENTILATION OF COAL MINES.—INSTANCE OF ITS SUCCESSFUL ADOPTION.

(From the *Gateshead Observer* as quoted from the *Mining Journal*.)



Sir,—It will be in the recollection of many, that Mr. Gurney, the discoverer of the Bude Light, suggested to the Parliamentary Committee, which in 1835 examined into the causes of accidents in coal mines, the application of high-pressure steam for procuring an increased force of ventilation; and again, in 1839, when the South Shields Committee, appointed to investigate the causes of accidents, were making their examinations, he more fully detailed the power, safety, cheapness, and facility of its application. Since that time it does not appear to have been at all noticed by scientific men. About the middle of this year, whilst in London, I attended a lecture (at the Polytechnic Institution in Regent-street, on a "Jet of Steam") in which the lecturer proved, by the experiments he made, the benefits to be derived in ventilation from high pressure steam. So convinced was I of its utility, that I determined to make the experiment at Seaton Delaval Colliery; and the plan has now been in operation one month, and has far exceeded my expectations.

There are four down-cast shafts, each 8 feet in diameter, and after making allowance for the cage-guides, buntons, &c., the area is 150 superficial feet. The upcasts are two, one of them 9 feet diameter, and the other 8 feet, giving an area of 113·8 superficial feet. The quantity of air circulating through the mine, previous to Gurney's steam apparatus being erected, was 53,058 cubic feet per minute; and since it was set to work the quantity has been 79,359 cubic feet per minute, which is an increase of nearly 50 per cent. The apparatus at present is only applied at one of the upcast shafts; and I am pretty confident if another were erected at the other upcast, a corresponding increase would be the result. A short time, however, will prove this, as one is in course of erection.

To myself this experiment affords the greatest gratification; as, before the apparatus was erected, carburetted hydrogen gas was occasionally seen at the edge of the goaves; but, since, it has entirely disappeared; and I entertain sanguine hopes it will not be met with at those points again.

I may be allowed to remark, that the extreme distance of the workings in Delaval Colliery from the shafts, in three districts, exceeds 1¼ mile; and there is no difficulty, with the present means, of obtaining a brisk circulation of air. In working the whole coal naked lights are used with perfect safety; but in working the pillars, or what is termed the "broken mine," the Davy Lamps are invariably used as a necessary precaution. I have forwarded you a drawing of the high-pressure steam apparatus, as applied at Delaval, with the necessary references; and I have only further to add, that I claim no credit to myself, except in making the first trial; for it is Mr. Gurney's invention, and to him alone is due the credit; and I should not have troubled you to insert these few remarks, but with the hope that they may be the means of inducing other parties, interested in this and other districts, to adopt this most useful and cheap mode of ventilating coal mines.

T. E. FORSTER.

Newcastle-on-Tyne, December 11.

Description of Engraving.

a, a, a—Jets of steam direct from the boiler.

B—Pipe from the boiler.

C—Exhausting pipe from the engine, branching into four others, *c, c, c, c*.

F—Furnace drift.

U—Upset-shaft.

[The situation of the pits from each other are exceedingly regular; two pairs of working pits, with that containing the steam apparatus, and the furnace pit, forming, as it were, another pair, run nearly north and south; the latter being south—while at nearly a mile distance to the south-west, are the furnace and engine pit, forming the extent of the workings in that direction.]

ON THE MOUNTING OF ORDNANCE ON THE NON-RECOIL PRINCIPLE — COMPILED FROM THE PAPERS OF THE LATE BRIG.-GEN., SIR SAMUEL BENTHAM.

Amongst the "Minutes of Evidence taken before the Select Committee on Navy, Army, and Ordnance Estimates," appears that of Captain Sir Thomas Hastings, late of the *Excellent*, now principal Storekeeper of the Ordnance, and who, in the year 1844, had been Chairman of a Commission to inquire into the state of the Coast Defences. Sir Thomas was questioned on the subject of the Coast Defences of our mercantile navy, &c.; and in relation to these matters, he said—"You would always arm your merchant steamers in war, *as the Scotch smacks were armed* between London and different parts of Scotland; *and a very excellent defence they were against privateers.*"

Those smacks, and other small coasting vessels, were armed with carronades, mounted on the *principle of non-recoil.*

Amongst the many improvements introduced by the late Brigadier-General Sir Samuel Bentham, none has encountered more determined and long-continued opposition than this principle; yet, perhaps, there is none which would contribute more to the combination of economy with efficiency in naval armaments, or to the protection in time of war of our mercantile navy. Many have been the objections started against this mode of arming; but it will appear in the sequel that the only plausible one amongst them is such as *mechanical skill* could readily obviate.

No. 7 of the Naval Papers relates entirely to the subject of arming: in the introduction to them, Sir Samuel observes:—

"If in the management of public concerns, after an established practice had been departed from, and notwithstanding great advantages had been derived from the change, the old practice is seen to have been resumed, it may well be supposed that, however important might have been these advantages, they were found to have been overbalanced by greater disadvantages: any attempt, therefore, to recur again to that innovation is likely to be ill-received, and the proposer to be regarded as the advocate of an ill-grounded measure.

"It is, however, under circumstances of this nature that I now lay before the public the following papers, intended to draw attention to a mode of arming vessels of war, which I had introduced, and which was adopted to a considerable extent during the time I filled the office of Inspector-General of Naval Works, but which has since been entirely abandoned. Although I am aware of the unfavourable impressions which this abandonment must excite as to my interference in the mode of arming His Majesty's fleet, yet far from wishing to screen from public notice, my endeavours relative to that part of my former public duty, circumstances now induce me to resume the subject, for the purpose of showing, by well-authenticated facts, that the discontinuance of that part of my mode of arming, which consisted in the mounting guns on the principle of *non-recoil*, was not the result of any inefficiency or impracticability either in

the principle itself or in the manner in which for several years it had been practically applied; and that the re-adoption of that principle, together with other improvements proposed in these papers, would not only be highly advantageous, as affording a means of more than *doubling* our naval force *without the addition* of a *ship* or a *man*, but that this advantage would be obtained with great facility and be attended with a considerable diminution of expense."*

As the Naval Papers referred to are out of print, it becomes expedient, in order to convey clear ideas on the subject, to state the objections which have been made to this mode of arming, and to show that they were groundless; for which objections Captain Brenton's Naval History may be taken as a text. The Captain records the remarkable action of the *Millbrook* schooner with the *Bellone* thus:—

"Carronade guns upon the non-recoil system were now coming into fashion. The *Millbrook* schooner, commanded by Lieutenant Matthew Smith, was fitted with them, and fought a very gallant action. This vessel which had 18 guns and 45 men, fell in off the bar of Oporto with a French ship privateer of 36 guns which she could not take,† but disabled her in such a manner as entirely to prevent her annoying the convoy of which she had charge. The *Millbrook* was too much disabled to pursue her enemy. It proved afterwards that she was the *Bellone* of 36 guns, and 320 men, 60 of whom were killed or wounded. Lieutenant Smith was deservedly promoted to the rank of commander and post captain.

"The mode of using these guns was thought at that period to possess great advantages, but experience has decided against them in the Navy, though they are still used in the merchant service. They are thought to destroy the upper works, to break their breechings, and dismount themselves, besides exposing the men outside the bulwarks in re-loading."*

That *experience* has decided against this principle cannot be admitted; for first, as to "destroying the upper works," experience, on the contrary, has proved that vessels, and ports of vessels, too weak to admit of mounting artillery on them so as to recoil, have been found strong enough to bear very heavy ordnance when mounted on the non-recoil system, and that in longcontinued action. This was first evinced in the heterogeneous flotilla fitted out by General Bentham in the year 1788, and which for three days maintained victorious actions in the Liman of Otchakoff with a Turkish fleet.† Subsequently the *Redbridge*, of 160 tons, armed with 14 carronades, 18 pounders, had "one of them one day loaded with three shot, which were all fired off with the full charge of powder without the least damage to the vessel." The *Dart*, in 1779, "fired 80 rounds without the ship being the least affected by it." The *Eling* schooner when the troops landed in Holland, fired 400 rounds from her aftermost carronade, without doing the slightest injury on board, or even breaking a single pane of glass in the cabin skylight. At Sir Sydney Smith's celebrated defence of Acre, by his direction, Mr. Bray, (carpenter of the *Tigre*), mounted on the non-recoil principle, two 68 pounder carronades in two djerms, a species of bark of 5 or 6 tons burthen, 43 feet in length by 15 in breadth; also a 24 pounder long gun, a 32 pounder carronade, and a 42 pounder howitzer on board a kind of lighter, 40 feet in length by 15 in breadth. All this ordnance was fixed on the non-recoil principle. The latter vessel was lashed to the two djerms, one on each side of her, by which a kind of floating battery was formed; and the five pieces were worked by the very small number of eleven seamen. "The djerms in which the guns were placed were *old*, and of *weak* construction; nevertheless they were not materially affected by the shock, except making them

* Many of the improvements here alluded to, and which were strenuously and repeatedly urged by Sir Samuel, have been by degrees introduced, such as the use of "carcasses and shells"—"substituting guns of large calibre for guns of small calibre," as recommended to Earl Spencer by letter as early as 18th January, 1798; as represented verbally to the Earl of St. Vincent, in February 1801, as also by letter to his Lordship on the 22nd of the same month; in which letter was also proposed "the introduction of howitzers and mortars, and in general of pieces of artillery of light weight."—See "Naval Papers," No. 7.

† The *Bellone* struck her colours, but the *Millbrook's* boats, being pierced with shot, filled with water on being launched, to take possession of her prize.

* "Brenton's Naval History of Great Britain," vol. ii., p. 520. Captain Brenton mistook the date of the action, saying it took place in 1801, whereas it really was 13th Nov. 1800.

† See *United Service Journal*, 1829, Part II., p. 333.

a little leaky towards the end of the siege, which lasted *sixty* days, although I kept up an *incessant fire*, particularly during the times when the enemy stormed the town."* These instances seem sufficient without quoting others, to prove that ordnance mounted on the non-recoil principle, does not destroy the upper works, or any other of the works of vessels so armed.

"To break the breechings."—In the above-mentioned instance, when the *Redbridge* had a carronade loaded with three shot, and when all her carronades were fired off with a full charge of powder, the same official report from her Commander stated that it was "without the least damage to the breeching." When the *Dart*, as above, fired her 80 rounds, it was "without the breeching being at all chafed." Many other such examples could be given from official documents, but surely these may suffice. By way of contrast, as to the effect on the breechings where guns are mounted to recoil, we may quote what SirEdward Pellew, of the *Indefatigable*, says in his letter to the Secretary of the Admiralty 17th January, 1797: "Some guns broke their breechings *four times over*, some drew the ring-bolts from their sides, and many of them were repeatedly drawn after loading." So, James's "Naval History" records that, when in the *Volage*, armed with 32 pounder carronades mounted to recoil in the usual way, the charge of powder was increased to extend their range, *every one of the breechings gave way*, and the *whole* of the carronades *upset* —an accident which, so far as is known, never once occurred to any one piece of ordnance, mounted on the principle of non-recoil by General Bentham.

"Exposing the men outside the bulwarks in re-loading."—This is the objection which to this day is urged against the principle of non-recoil; it is this which seems so very plausible, that enlightened officers consider it as insuperable; not that danger to the men from great guns seems to be apprehended, but that the men would be picked off by the musquetry of the enemy: and it is this plausible imperfection which mechanical skill is called upon to do away.

It however appears from experience that this danger, evident as it may at first sight seem, does not in fact exist. In the action of the *Millbrook* with the *Bellone*, sixty at least in the French ship were killed and wounded; a French newspaper of the time said that no less than eighty of her crew were killed by the *Millbrook's* fire; yet on board the *Millbrook*, *not a man* was killed! After the many other actions in which the experimental sloops and schooners so armed were engaged, there never was a single surmise at the time that casualties had been excessive. Not even on board the *Arrow* and the *Dart*, when these sloops at the attack on Copenhagen, 1801, were placed by Lord Nelson under the Crown Batteries, the most exposed of situations, were the casualties on board any greater than in other vessels of the attacking squadron.* The several successive captures of the experimental vessels, never admitted that their crews were more exposed than on board other vessels; nay, many of them professed that their men were safer than usual, and attributed this happy result to the great rapidity with which non-recoil guns were fired.

To conclude this reply to objections—as it was considered that the attack on Copenhagen, 1801, had proved a severe trial of General Bentham's mode of mounting artillery on the non-recoil principle, the lieutenant of the *Dart*, on the 23rd July, 1803, was questioned "about the Copenhagen fight, how the *Dart's* guns stood, how many breechings they broke, how quick they fired? &c." The lieutenant replied, "The guns stood well—no breeching was broke—would continue to fire twice or three times as quick as other guns—and was two hours and a half in action, with the guns all perfect." Lord Nelson must have reckoned that guns mounted non-recoil, could be fired thrice for once of those mounted in the usual way, when he estimated the *Dart* and *Arrow* as

* Extract from Mr. Bray's Memorandum, 21st Nov., 1803: inclosed by the Inspector-General of Naval Works to the Secretary of the Admiralty, 25th Nov., 1803.

* In a letter from Mr. J. Peake to Sir Samuel Bentham, Mr. Peake says, "I have cut out the inclosed for you to see how Lord Nelson placed the *Arrow* and *Dart*; he said to me that he considered them to be of more *effective force* than the 90-gun ships—it is evident, as he placed them against these formidable batteries." The plan of this attack, as given by Captain Brenton, differs materially from those that were printed soon after the occurrence.

being equal, in effective force each, to a 90 gun ship.

As to arming trading vessels in time of war, as recommended by Sir Thomas Hastings, like the Scotch smacks—this measure originated with Sir Samuel Bentham, as appears by his letter to Earl Spencer, 20th July, 1798, and by a mass of subsequent official correspondence; it was adopted conformably to his proposals, and was carried into execution according to his directions. The eminent success which attended the measure, rested mainly on mounting the ordnance on board those vessels on the principle of non-recoil. It seems important to our mercantile navy to be apprized of a few particulars of that success, since, by a similar armament, no prejudice results to the vessels as traders, and their guns so mounted can be worked without augmentation of their ordinary crews—advantages hardly to be hoped for from the mode of arming, provided for in regard to hired packets.

Of the Scotch smacks spoken of by Sir Thomas Hastings, the first of them attacked was the *King George;* her crew consisted of eleven persons, one of them a man without an arm, another of them a *woman.* The *King George* was hailed to *strike*, or be *sunk*, by a French brig privateer, armed apparently with at least 16 guns, and, as far as could be guessed, a crew of from 100 to 120 men. The privateer was beaten off, nay, ran away,—the smack of course did not run after her. The captain in this affair was slightly wounded, but soon recovered. After this time, the smacks usually sailed two of them together.

The *Queen Charlotte* packet, of Leith, January 24th, 1804, had an engagement off Cromer with a French brig privateer of 14 guns, a new vessel, and full of men; broadsides were fired from both vessels; the engagement lasted for an hour and thirty-five minutes, when the *Queen* came off "victorious."

General Bentham proposed that all the navy transports should be armed in this mode. The Navy Board were averse to it, when on the 25th June, 1803, one of the surveyors of the navy being at Deptford, proposed going on board one of the transports then lying there, to "see what could be done." "Well, Captain Pope, how were your former guns?"—Pope, "Useless, and almost dangerous." Surveyor, "And how would carronades do?" (Master Shipwright, "Carronades mounted on the non-recoil principle.") Pope, "That is what we want; then we could take care of ourselves, and not only that, but convoy all the trade up and down the Channel. We were useless last war, and very often, in waiting for convoy, we lost our passage, and the service suffered very much." Surveyor, "But if you have carronades you will want more men."—Pope, "No; less to the guns." Surveyor, "And do you think, Captain Pope, that if you had such carronades you could defend yourselves?"—Pope, "Yes, and be sufficient convoy for all the trade without a man-of-war: and, as some of us, would be always going up and down Channel, the trade would never have to wait for a convoy; and men-of-war might never be kept waiting; they might go on other services." Master Attendant, "Yes, and if all the dockyard transports were armed with such carronades, the Navy Board might discharge all the *hired* transports, as the yard transports would be equal to all the work."—Pope, "I could make three voyages for one."*

Neither this nor other equally strong opinions, could induce the Navy Board to arm more than one of their transports according to this mode.

The advantages of mounting ordnance on the non-recoil principle, may be briefly enumerated as follows:—

1. Quick firing; some say twice, others thrice as fast as by the usual mode.†

2. Only half the usual number of men required—and even a *single* man can

* This conversation was alluded to in the Inspector-General's letter to the Secretary of the Admiralty, 26th July, 1803. The heavy transports as then armed in the usual mode, threw in one round a weight of shot of 32 lbs.; according to Sir Samuel's mode, 192 lbs. were thrown in each round.

† In the action of the *Millbrook* with the *Bellone*, "before the *Bellone* could bring her second broadside to bear, the *Millbrook* had fired *three* broadsides; and by the time the former had fired her third, the schooner had discharged *eleven* broadsides. Such was the rapidity of firing where no time was lost by running out the guns. The *Millbrook's* carronades were seemingly fired with as much precision as quickness, for the *Bellone* from broadsides fell to single guns, and showed by her sails and rigging how much she had been cut up by the schooner's shots." James's "Naval History," vol. ii., p. 482—4. On board the *Porcupine*, 24 guns, Captain Evans, when in Torbay, a 24 pounder carronade was fired, shotted, *seven* times in ninety-five *seconds*.

continue to fire a carronade of the largest calibre in cases of urgency.

3. Should the men be called away from their gun for other duties, it can be left without staying to secure it.

4. No weather too bad to prevent the use of a gun, so long as a man can stand to load it.

5. Guns so mounted, never jump.

6. The strain on the breeching is less in firing than when guns are mounted on the usual mode.

7. Vessels not built for purposes of war, are, any of them, strong enough for this mode of mounting the largest carronades, since in this manner they can be fixed to parts of vessels sufficiently strong, though the timbers be weak.

8. Guns so mounted occupy little space, and do not encumber the decks with relieving tackle, or come in the way of large hatchways.

9. Weight of the carriage not more than a third of that of a usual carriage.

10. Time for manufacturing a carriage, about a third of that for a carriage in the usual mode.

11. Expense of a carriage about a third of the usual cost.

12. Simplicity of the carriage and apparatus.

13. Shot thrown considerably farther, than when the gun from which it is fired is suffered to recoil—hence the expedient resorted to in the navy of *lashing* a gun.

Such being the advantages of the non-recoil principle, as proved by the examples above given, it now remains for the mechanical genius of the day, to remove the only plausible objection to a very general adoption of that principle, namely,—exposure of the men in loading,—and however falacious that objection may heretofore have proved in actual warfare, it well deserves attention, and would well reward any invention that would remove it.

Sir Samuel Bentham has indicated that the object in view might be attained, either by improving upon the attempts that have been made to load a gun at the breech, or by "contriving an apparatus for loading the gun at the *ex*terior of the port, without either drawing the gun in or placing the men outside, or the loading at the breech."* In the year 1830 he had himself devised such an apparatus, with the efficiency of which he expressed himself well satisfied; but neither drawing nor note has been found indicating the particulars of this invention.

Should any engineer, civil or military, be disposed to re-introduce the non-recoil mounting of ordnance, the following memoranda of desiderata may be of use; they were deemed of importance at the beginning of this century, and may be so still.

That by means of a chock of greater or less thickness, the height of the carriage be adapted to the height of the port sill.

That the carronade be so adjusted according to the thickness of the side of the vessel, as to ensure against danger of setting fire to the ship.*

That the breechings be of rope of a good make, and well stretched before being roven.

Sizes of breechings found suitable in actual service:—

for a 32 pounder carronade	9	inches.
,, 24	8½	,,
,, 18	7½	,,
,, 12	6	,,

That the cascabel rings be sufficiently opened to receive these breechings, and that the opening be duly rounded off and smoothed.

That the bolsters be duly rounded off and smoothed.

That on the outside of the vessel the breechings be let into grooves in the chocks, so as to protect the breechings from being rubbed against, when alongside of other vessels.

That the rammer be of rope, or of other *flexible* material, as by this expedient the men while ramming in the shot are not exposed to the enemy's fire.

That for training the gun, *rolling* handspikes be provided.†

That where it should be expedient to cut holes for the breeching in the vessel's side, great care be taken to line them with lead, or other material, as scuppers are lined, to prevent leakage, and to form a smooth surface for the breeching to pass over.

* Naval Papers, No. 7, page 13.

* When the direction of fitting ships on this principle was taken from Sir Samuel and confided to the Navy Board, vessels were so fitted that the carronade could not be fired without setting fire to the vessel.

† A model of this invention of Sir Samuel Bentham, was presented to the Secretary of the United Service Museum. to be there deposited.

ASTRONOMY AND ALGEBRA.— THE DISTANCE OF THE SUN FROM THE EARTH DETERMINED INDEPENDENTLY OF PARALLAX.

[At the earnest request of the writer, we republish from the *Ipswich Chronicle*, of Saturday last, the following notable challenge to the Mathematical world.—ED. M. M.]

To the Mathematicians of the Nineteenth Century.

Gentlemen, — The under-mentioned equations demonstrate and prove the distance of that beautiful luminary the sun, (independently of parallax or transitorial phenomena), and will, I hope, set at rest all mistrust upon this grand and sublime question, which has engaged the attention of all lovers of astronomy, ever since the cultivation of science began. The data which I employ are the lengths of the apparent day and night on the longest and shortest days of the year, the radius of the globe we inhabit, and the versed sine of the obliquity of the ecliptic.

With this data, and the known fact that the earth moves nearly in an elliptical orbit, I deduce two independent equations, and having the same number of unknown quantities, their respective values are truly limited to a known, definite, and satisfactory result. The absolute values of the required quantities, will prove the nice accuracy of the distance (obtained by a transit of Venus over the sun's disk), but they will also demonstrate an error, respecting the eccentricity of the earth's orbit, or half distance between the foci; consequently the ellipse will be much nearer to a circle than astronomers have hitherto considered it to be.

I am well aware by making these remarks I place myself antagonistical with mathematicians upon this subject, but truth and demonstration will ultimately prevail over authority and unintentional error. In conclusion, and for the sake of publicity, I entreat all gentlemen who are willing to aid pure algebra, to make these equations as public as they possibly can; for I wish them to stand the test of the learned; by so doing, they will succour the cause of science in one of the noblest, grandest, most sublime of all questions that ever came under the cognizance of erring man.

I remain, Yours, &c.,

JOHN KING,
Algebraist.

Upper Brook-street, Ipswich, Suffolk,
December 23, 1848.

$$\frac{(\infty - y)\,e^2}{4\infty y\,(\infty + y) + (\infty - y)^2 z} = \frac{\sqrt{4\infty^2 y^2 + (\infty - y)^2 e^2} - 2\infty y}{(\infty - y)^2}$$

$$b\infty = ay$$

			Seconds.
Data.	a = the length of the day on 21st Dec.	=	86430·04
	b = ,, ,, 21st June	=	86412·93
	e = the earth's equatorial radius	=	3962·5 miles.
	z = versed sine 23 deg. 27 min. 22·81 sec.	=	·0826363238

∞ = the distance of the sun on the longest day.
y = ,, ,, on the shortest.

GREAT LONDON DRAINAGE PLAN.—TO AFFORD MEANS FOR EFFECTUALLY DRAINING THE METROPOLIS; TO PRESERVE THE THAMES FROM THE IMPURITIES AT PRESENT PASSING INTO IT; AND TO COLLECT ALL THE PRODUCE OF THE SEWERS FOR APPLICATION TO AGRICULTURAL PURPOSES. BY J. J. MOREWOOD, ESQ.*

Before a remedy can be appreciated, the extent and cause of the evils complained of must be understood. It is therefore deemed well to make some preliminary remarks, with the view of elucidating our actual position, in respect to the effectual drainage of the metropolis; the preservation of the Thames from the impurities at present passing into it; and the collection of the produce of the sewers for agricultural purposes.

The level of the Thames is far too high for the metropolis to be drained into it. Many localities lie scarcely above high water-mark. A sewer constructed at a depth of twelve feet, is very inadequate to drain the houses; and yet it is to that extent under high water, and cannot empty itself, excepting when the Thames shall have receded towards low water. During

* Published separately in a pamphlet form by Mr. Effingham Wilson.

this retention of the refuse in the sewers, and by the deposit formed in consequence of its being at rest, there arises those causes of complaint which are daily becoming more manifest; and of all evils which have ever been propounded for the destruction of a town, there is probably none greater than that of the removal of all offensive house refuse into the sewers, for the purpose of its being conveyed into the Thames.

The strictest laws were formerly in existence to prevent the pollution of the Thames; and Courts of Conservancy are still not completely abrogated. The evasion of the laws referred to, and the adoption of modern house arrangements (water closets), has produced so injurious an effect on the Thames water, that the city of London has now, for many years, interdicted its use, even for watering the streets.—The general flatness of the drainage area has involved us in a most serious difficulty. The name of the "Tidal River Fleet," was first changed into the "Fleet Sewer,"—"Ponds," "Canals," "Rivulets," "Brooks," and ornamental Park waters, are all assuming the character of stagnant sewers. Cesspools, which when kept dry, are by no means very offensive, are now everywhere overflowing, the liquid soaking into wells; while, to crown all, the Thames, the natural inlet of air, and the chief opening for ventilating 300,000 houses, itself injures the atmosphere with exhalations, producing the very diseases which all are desirous to avert. If proof were wanting "that Typhus Fever and Cholera" "are intimately connected with sewer-mouths, and rivers receiving the contents of sewers," it is afforded by the virulence of the late cases of cholera on board the hulks at Woolwich, immediately above the spot where a sewer empties itself into the Thames.

Again,—the difficulty which exists in respect to the removal and use of the refuse of the metropolis, arises from its lying in a hollow or dead level; and from the enormous quantity which has accumulated, and which is daily produced. The land within seven miles, cannot take one half of the solid manure which must be constantly got rid of. The remaining portion has to be sent to a greater distance, at a very considerable cost, and the most valuable of all manures is only removed from houses at a heavy charge to the inhabitants. Beyond all this vast quantity of solid manure, there are the liquid contents of all the sewers to be disposed of. Any comprehensive plan must be adopted to the removal of 200,000,000 tons of liquid annually. While this is worse than wasted, 6,000,000 acres of land remain uncultivated in England alone, the Labour Question and the Support of the Poor naturally involving us continually in new difficulties.

It is evident from the above, that the metropolis requires a lower level for its drainage than that which it at present possesses; and, to preserve the Thames from pollution, a locality is required into which the refuse can be safely and advantageously conveyed.

The plan which is adapted to effect these objects, consists in the construction of two main trunk channels, or sewers, one on each side of and nearly parallel with the Thames. These sewers will be made by boring or tunnelling, so as to avoid interference with the streets, under which they will pass at such a depth, as to insure the safe execution of the work, and the perfect drainage of the lowest localities of the metropolis. They will commence in the East and will pass in a westerly direction, under the existing sewers, the contents of which (instead of flowing into the Thames) will pass through the shafts into the lower proposed sewer. As the natural drainage area does not afford sufficient fall, an additional fall or inclination will be given to the new subterranean aqueduct, and the refuse will flow eastward, into a deep well, or receptacle, out of which it will be constantly pumped, so as to prevent all interruption to the current of the contents of the present sewers. All offensive effluvia will be destroyed before the liquid will be raised, and it will then be adapted for use over the contiguous country, or sold in a moist or dry state—like guano.

This plan is perfectly adapted to the whole drainage area of the metropolis. The house drainage and sewerage, which exist, will not be interfered with, but made efficient. By an additional fall being given, all difficulty in respect to drainage ceases, and all new sewers may, in consequence, be constructed of a much smaller size.

Nearly every one of the objects enumerated in the appointment of the Sanitary Commission has been very fully considered, and the required alleviation and remedy is contained in the plan proposed. The Thames being preserved from the pollution now poured into it, will be again available for use; and there is no work, the execution of which will, in the present day, confer equal advantages on the metropolis and on the country generally—nor can any work be undertaken, of a more re-productive character.

These are subjects which concern every one of the inhabitants, who having fouled

the natural source of their supply of water, have to pay exorbitantly for that which is brought from a distance; and who are so heavily taxed for the removal of that refuse, which, at the most moderate estimate, is worth several hundred thousand pounds a year.

There can be no greater danger to a city, than that its river should become its enemy; nor any greater danger to a country, than that its fields lie uncultivated; and the question which every one is bound by his duty to the public to answer, resolves itself into this, "What can I do to remove the existing sources of danger to the metropolis, and to the country at large?"

London, December 18, 1848.

ON THE STRENGTH OF MATERIALS, AS INFLUENCED BY THE EXISTENCE OR NON-EXISTENCE OF CERTAIN MUTUAL STRAINS AMONG THE PARTICLES COMPOSING THEM. BY JAMES THOMSON, JUN., M.A., COLLEGE, GLASGOW.

[From the *Cambridge and Dublin Mathematical Journal*. Nov. 1848.]

My principal object in the following paper is to show that the absolute strength of any material composed of a substance possessing ductility (and few substances, if any, are entirely devoid of this property), may vary to a great extent, according to the state of tension or relaxation in which the particles have been made to exist when the material as a whole is subject to external strain.

Let, for instance, a cylindrical bar of malleable iron, or a piece of iron wire, be made red hot, and then be allowed to cool. Its particles may now be regarded as being all completely relaxed. Let next the one end of the bar be fixed, and the other be made to revolve by tortion, till the particles at the circumference of the bar are strained to the utmost extent of which they can admit without undergoing a permanent alteration in their mutual connection.* In this condition, equal elements of the cross section of the bar afford resistances proportional to the distances of the elements from the centre of the bar; since the particles are displaced from their positions of relaxation through spaces which are proportional to the distances of the particles from the centre. The couple which the bar now resists, and which is equal to the sum of the couples due to the resistances of all the elements of the section, is that which is commonly assumed as the measure of the strength of the bar. For future reference, this couple may be denoted by L and the angle through which it has twisted the loose end of the bar by θ.

The twisting of the bar may, however, be carried still farther, and during the progress of this process the outer particles will yield in virtue of their ductility, those towards the interior assuming successively the condition of greatest tension; until, when the twisting has been sufficiently continued, all the particles in the section, except those quite close to the centre, will have been brought to afford their utmost resistance. Hence, if we suppose that no change in the hardness of the substance composing the material as resulted from the sliding of its particles past one another; and that, therefore, all small elements of the section of the bar afford the same resistance, no matter what their distances from the centre may be; it is easy to prove that the total resistance of the bar is now $\frac{4}{3}$ of what it was in the former case; or, according to the notation already adopted, it is now $\frac{4}{3}L$.*

* I here assume the existence of a definite "*elastic limit*," or a limit within which if two particles of a substance be displaced, they will return to their original relative positions when the disturbing force is removed. The opposite conclusion, to which Mr. Hodgkinson seems to have been led by some interesting experimental results, will be considered at a more advanced part of this paper.

* To prove this, let r be the radius of the bar, η the utmost force of a unit of area of the section to resist a strain tending to make the particles slide past one another; or to resist a shearing strain, as it is commonly called. Also, let the section of the bar be supposed to be divided into an infinite number of concentric annular elements; the radius of any one of these being denoted by x, and its area by $2\pi x dx$.

Now, when only the particles at the circumference are strained to the utmost; and when, therefore, the forces on equal areas of the various elements are proportional to the distances of the elements from the centre, we have $\eta \frac{x}{r}$ for the force of a unit of area at the distance x from the centre. Hence the total tangential force of the element is

$$=2\pi x dx . \eta \frac{x}{r},$$

and the couple due to the same element is

$$=x . 2\pi x dx . \eta \frac{x}{r} = 2\pi\eta \frac{1}{r} . x^3 dx:$$

and therefore the total couple, which has been denoted above by L, is

$$=2\pi\eta \frac{1}{r} \int_0^r x^3 dx,$$

that is,

$$L = \tfrac{1}{2}\pi\eta r^3 \ldots\ldots\ldots\ldots (a).$$

Next, when the bar has been twisted so much that all the particles in its section afford their utmost resistance, we have the total tangential force of the element

$$=2\pi x dx . \eta,$$

and the couple due to the same element

If, after this, all external strain be removed from the bar, it will assume a position of equilibrium, in which the outer particles will be strained in the direction opposite to that in which it was twisted and in the inner ones in the same direction as that of the twisting, the two sets of opposite couples thus produced among the particles of the bar balancing one another. It is easy to show that the line of separation between the particles strained in the one direction, and those in the other, is a circle whose radius is $\frac{3}{4}$ of the radius of the bar. The particles in this line are evidently subject to no strain* when no external couple is applied. The bar with its new molecular arrangement may now be subjected, *as often as we please*,† to the couple $\frac{4}{3}L$, without undergoing any farther alteration; and therefore its ultimate strength to resist torsion, in the *direction of the couple L*, has been considerably increased. Its strength to resist torsion in the opposite direction has, however, by the same process, been much diminished; for, as soon as its free extremity has been made to revolve backwards through an angle of $\frac{2}{3}\theta$ from the position of equilibrium, the particles at the circumference will have suffered the utmost displacement of which they can admit without undergoing permanent alteration. Now it is easy to prove that the couple required to produce a certain angle of torsion is the same in the new state of the bar as in the old.‡ Hence the ultimate strength of the bar when twisted backwards, is represented by a couple amounting to only $\frac{2}{3}L$. But, as we have seen, it is $\frac{4}{3}L$ when the wire is twisted forwards. That is, then, *The wire in its new state has twice as much strength to resist torsion in the one direction as it has to resist it in the other.*

Principles quite similar to the foregoing, operate in regard to beams subjected to cross strain. As, however, my chief object at present is to point out the existence of such principles, to indicate the mode in which they are to be applied, and to show their great practical importance in the determination of the strength of materials, I need not enter fully into their application in the case of cross strain. The investigation in this case closely resembles that in the case of torsion, but is more complicated on account of the different ultimate resistances afforded by any material to tension and to compression, and on account of the numerous varieties in the form of section of beams which for different purposes it is found advisable to adopt. I shall therefore merely make a few remarks on this subject.

If a bent bar of wrought iron, or other ductile material, be straightened, its particles will thus be put into such a state, that its strength to resist cross strain, in the direction towards which it has been straightened, will be very much greater than its strength to resist it in the opposite direction, each of these two resistances being entirely different from that which the same bar would afford, were its particles all relaxed when the entire bar is free from external strain. The actual ratios of these various resistances depend on the comparative ultimate resistances afforded by the substance to compression and extension; and also, in a very material degree, on the form of the section of the bar. I may however state that in general the variations in the strength of a bar to resist cross strain, which are occasioned by variations in its molecular arrangement, are much greater even than those which have already been pointed out as occurring in the strength of bars subjected to torsion.

What has been already stated is quite sufficient to account for many very discordant and perplexing results which have been arrived at by different experimenters on the strength of materials. It scarcely ever occurs that a material is presented to us, either for experiment or for application to a

$$=x.2\pi x dx.\eta=2\pi\eta.x^2dx.$$

Hence the total couple due to the entire section is

$$=2\pi\eta\int_0^r x^2dx=\tfrac{2}{3}\pi\eta r^3.$$

But this quantity is $\frac{4}{3}$ of the value of L in formula (a). That is, the couple which the bar resists in this case is $\frac{4}{3}L$, or $\frac{4}{3}$ of that which it resists in the former case.

* Or at least they are subject to *no strain of torsion* either in the one direction or in the other; though they may perhaps be subject to a strain of compression or extension in the direction of the length of the bar. This, however, does not fall to be considered in the present investigation.

† This statement, if not strictly, is at least extremely nearly true: since from the experiments made by Mr. Fairbairn and Mr. Hodgkinson on cast iron (See various *Reports of the British Association*), we may conclude that the metals are influenced only in an extremely slight degree by time. Were the bars composed of some substance, such as sealing wax, or hard pitch, possessing a sensible amount of viscidity, the statement in the text would not hold good.

‡ To prove this, let the bar be supposed to be divided into an infinite number of elementary concentric tubes (like the so-called annual rings of growth in trees); to twist each of these tubes through a certain angle, the same couple will be required whether the tube is already subject to the action of a couple of any moderate amount in either direction, or not. Hence, to twist them all, or what is the same thing, to twist the whole bar, through a certain angle, the same couple will be required whether the various elementary tubes be or be not relaxed, when the bar as a whole is free from external strain.

practical use, in which the particles are free from great mutual strains. Processes have already been pointed out by which we may at pleasure produce certain peculiar strains of this kind. These, or other processes producing somewhat similar strains, are used in the manufacture of almost all materials. Thus, for instance, when malleable iron has received its final conformation by the process termed *cold swaging*, that is by hammering it till it is cold, the outer particles exist in a state of extreme compression, and the internal ones in a state of extreme tension. The same seems to be the case in cast iron when it is taken from the mould in which it has been cast. The outer portions have cooled first, and have therefore contracted while the inner ones still continued expanded by heat. The inner ones then contract as they subsequently cool, and thus they as it were pull the outer ones together. That is, in the end, the outer ones are in a state of compression, and the inner ones in the opposite condition.

The foregoing principles may serve to explain the true cause of an important fact observed by Mr. Eaton Hodgkinson in his valuable researches in regard to the strength of cast iron (*Report of the British Association* for 1837, p. 362).* He found that, contrary to what had been previously supposed, a strain, however small in comparison to that which would occasion rupture, was sufficient to produce a set in the beams on which he experimented. Now this is just what should be expected in accordance with the principles which I have brought forward; for if, from some of the causes already pointed out, various parts of a beam previously to the application of an external force have been strained to the utmost, when, by the application of such force, however small, they are still farther displaced from their positions of relaxation, they must necessarily undergo a permanent alteration in their connection with one another, an alteration permitted by the ductility of the material; or, in other words, the beam as a whole must take a set.

In accordance with this explanation of the fact observed by Mr. Hodgkinson, I do not think we are to conclude with him, that "the maxim of loading bodies within the elastic limit has no foundation in nature." It appears to me that the defect of elasticity which he has shown to occur even with very slight strains, exists only when the strain is applied for the first time; or, in other words, that if a beam has already been acted on by a considerable strain, it may again be subjected to any smaller strain in the same direction without its taking a set. It will readily be seen, however, from Mr. Hodgkinson's experiments, that the term "elastic limit," as commonly employed, is entirely vague, and must tend to lead to erroneous results.

The considerations adduced seem to me to show clearly that there really exist *two elastic limits* for any material, between which the displacements or deflexions, or what may in general be termed the changes of form, must be confined, if we wish to avoid giving the material a set; or, in the case of variable strains, if we wish to avoid giving it a continuous succession of sets, which would gradually bring about its destruction: that these two elastic limits are usually situated one on the one side, and the other on the opposite side of the position which the material assumes when subject to no external strain, though they may be both on the same side of this position of relaxation,* and that they may, therefore, with propriety be called the *superior* and the *inferior limit* of the change of form of the material for the particular arrangement which has been given to its particles; that these two limits are not *fixed* for any given material; but that if the change of form be continued beyond either limit, two new limits will, by means of an alteration in the arrangement of the particles of the material, be given to it in place of those which it previously possessed: and lastly, that the processes employed in the manufacture of materials are usually such as to place the two limits in close contiguity with one another.

* For further information regarding Mr. Hodgkinson's views and experiments, see his communications in the *Transactions of the Sections of the British Association* for the years 1843 (p. 23) and 1844 (p. 25), and a work by him, entitled *Experimental Researches on the Strength and other Properties of Cast Iron*. 8vo. 1846.

* Thus, if the section of a beam be of some such form as that shown in either of the accompanying figures, the one rib or the two ribs, as the case may be, being very weak in comparison to the thick part of the beam, it may readily occur that the two elastic limits of deflexion may be situated both on the same side of the position assumed by the beam when free from external force. For if the beam has been supported at its extremities and loaded at its middle till the rib *AB* has yielded by its ductility

so as to make all its particles exert their utmost tension, and if the load be now gradually removed, the particles at *B* may come to be compressed to the utmost before the load has been entirely removed.

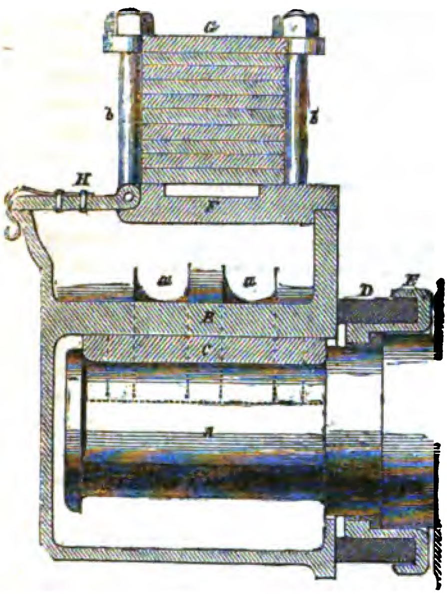
other, thus causing the material to take in the first instance a set from any strain, however slight, while the interval which may afterwards exist between the two limits, and also, as was before stated, the actual position assumed by each of them, is determined by the peculiar strains which are subsequently applied to the material.

The introduction of new, though necessary, elements into the consideration of the strength of materials may, on the one hand, seem annoying from rendering the investigations more complicated. On the other hand, their introduction will really have the effect of obviating difficulties, by removing erroneous modes of viewing the subject, and preventing contradictory or incongruous results from being obtained by theory and experiment. In all investigations, in fact, in which we desire to attain, or to approach nearly, to truth, we must take facts as they actually are, not as we might be tempted to wish them to be, for enabling us to dispense with examining processes which are somewhat concealed and intricate, but are not the less influential from their hidden character.

IMPROVEMENTS IN PRINTING MACHINERY.

Not long since we gave a notice of a printing machine of a new construction, (with vertical instead of horizontal cylinders) which had been invented by Mr. Applegath, for the proprietors of the TIMES newspaper, and was expected to throw off not less than 14,400 sheets per hour (9,500 more then the best machines previously in use were capable of producing), or at the astonishing rate of 240 a minute! (See vol. xlvii. p. 272). Many were the speculations concerning this new mechanical prodigy. By some it was pronounced to belong to the class of sheer impossibilities, and there were a few things to amend, (for what machine ever worked perfectly well at first?) which caused a pause in the use of it, that gave some countenance to their incredulity; while others, not less competent to judge, expressed the utmost confidence that it would, in the end, accomplish all that was predicted of it. Although we are not yet able to announce that the goal has been reached, which the inventor (possibly too sanguine,) had prescribed for himself, we have, nevertheless, the satisfaction of knowing that he has advanced so far towards it, as quite to confound the doubtful. The machine is now in daily use, producing at the rate of 8000 sheets of the enormous double size of the Times per hour, and that is more than any printing machine ever did before; and, no doubt, as the hands get more accustomed to feeding it, and as sources of hindrance hitherto overlooked get detected and remedied, the rate of production will be, ere long, very greatly augmented.

We had a few days ago an opportunity of inspecting two other printing machines of the same monster class, and which are in their way equally remarkable, that have been built by the Messrs. Dryden, and are to be employed in the printing of the WEEKLY DISPATCH, in the vastly enlarged form which it is to assume with the beginning of the new year. The cylinders to these machines are not worked vertically like those of the *Times*, out are placed horizontally as usual; which may be owing either to Mr. Applegath's having a monopoly of his plan of construction, or to that plan being considered as still of too tentative character to justify its general adoption. Messrs. Dryden's machines are the largest of their own class ever built; and the most efficient too, for they produce at the rate of 5800 copies an hour—though worked by a steam-engine of only some 10 or 12 horse power, and with the steam at a pressure of not more than 15 lbs. per square inch. We have inspected them minutely, and feel it but due to the makers to say, that they are also the best we have ever seen in point of accuracy and beauty of workmanship. Huge of size as they are, and wonderfully rapid their movements, they work with the nicety, smoothness, and precision of a hand-press employed at a snail's pace on fine book-work, or on rare engravings. The Messrs. Dryden have well seconded the spirited resolve of the proprietors of the DISPATCH to keep at the head of the weekly press, as well as by the quantity as the quality of the information supplied to their readers; and in the success of both we may see strikingly exemplified, how popular intelligence and mechanical invention, act and react on one another to the great benefit and honour of both.



Two axle boxes have been recently patented which have attracted a good deal of attention, and become the subject of a somewhat unpleasant paper war between the patentees; namely, one by Mr. Wrighton, and the other by Mr. Normanville. Mr. Wrighton says that both boxes are essentially the same; that he is not only "the first and true inventor," but also the first patentee, and that Mr. Normanville is but a clever plagiarist who has the good luck to be very powerfully patronised; to all which Mr. Normanville (of course) very decidedly demurs. We have before given an account of the axle as patented by Mr. Normanville (see *ante* p. 453), and now propose to do the like justice by Mr. Wrighton's edition of the invention. Our readers will thus be enabled to judge for themselves which party is in the right. For our own parts we incline to think (as our neighbour of "85" would doubtless do) that the first patentee is the *Wright-on*.

The above engraving represents a longitudinal section of the axle-box in its most approved form, through the centre of the journal, A, of the axle. This journal revolves in the brass step C, fitted into the axle-box B, which is cast in one piece, or otherwise so made as only to leave an opening on its face for the introduction of the journal of the axle. D is a ring of vulcanised India-rubber, which is compressed between the face of the axle-box and the ring E, which works against a shoulder on the axle, and against which it is pressed by the elasticity of the India-rubber ring, and in both of which the axle freely revolves; *a a* are apertures at the sides through which the grease passes from the grease-box to the journal and interior of the axle-box. The object of making the grease pass down the sides is to save diminishing the bearing surface of the brass by drilling large grease holes. The spring G rests on the plate F which covers the grease-box, and carries the grease cover H, made to fit sufficiently accurate to exclude dust and dirt, the whole being secured to the axle-box by the bolts *b b*.

In applying the axle-box, the metal ring encircled by the India-rubber ring should be first put on the axle; the axle-box with the brass step in its place being filled with grease, is then to be applied to the journal and pressed towards the nave of the wheel, compressing the India-rubber ring until the bearing drops on to its seat. The shoulder of the journal will prevent the axle-box from being forced back again by the elasticity of the India-rubber ring, which will press on one side against the face of the axle-box, and on the other against the metal ring, and keep it close up to the shoulder on the axle, and prevent the grease escaping and dust or grit getting to the journal.

It is quite unnecessary to apply pins or fastenings of any kind to confine the India-rubber ring, the adhesion between it and the face of the box being much greater than the friction between the two metal faces.

The extreme simplicity and economy of this invention, with its great advantages, must be obvious from the description; the axle-box itself requires no fitting, polishing, or facing of any kind, nor the application of a polished plate fixed by bolts or screws. It may be used as it comes from the foundry. The only thing necessary to look to, is to see that the plate and cover close the grease-box sufficiently to exclude the dust and dirt; the metal ring need only to be turned where it is in contact with the axle.

The shoulder for it to work against can be made either by turning the axle a little smaller, as shown in the engraving, or by driving or shrinking on a metal collar, faced and bored to fit it. The first method may be pursued when the axle-boxes are being fitted to new axles, or those not in use, and both can be placed under the carriages when required; but in applying them to axles under carriages in use, the latter method is preferable, as a number of collars may, if required, be prepared, and shrunk or driven

on, and the boxes fitted in the course of a few minutes.

Common axle-boxes of any description may, with little trouble and expense, be altered to the patent ones, simply by making the usual joint in the middle tight, stopping the holes at the bottom left for the escape of the grease, and applying the metal and India-rubber rings as shown. This alone would save a great expense to railway Companies wishing to use the patent axle-boxes, and having a large stock of common ones on hand.

As a practical proof of the efficiency and economy of Mr. Wrighton's invention, it may be sufficient to state, that after some experiments on the Eastern Union Railway, a second-class carriage was fitted with the patent axle-boxes, which has now been running about four months, and has travelled more then five thousand miles without lifting or requiring a renewal of grease; and at the present time, there is not the slightest appearance of their requiring any, as the grease-boxes are as full now as when first put to work.

ENGLISH SPECIFICATIONS ENROLLED DURING THE WEEK ENDING DEC. 29.

Deane Samuel Walker, London-Bridge, merchant. *For improvements in the manufacture of bands or straps for hats, caps, shoes, and socks.* Patent dated June 24, 1848; specification enrolled December 30, 1848.

The patentee, who disclaims the whole of his title except that which refers to hats, states that his invention consists, 1st. In making the body of the hat of any tubular woven, looped, or pile-cut fabric, which he stiffens and attaches to a brim and crown in the ordinary manner. 2nd. In applying tubular woven, looped, or pile-cut fabrics as mourning bands to hats. 3rd. In cementing to the inside of a mourning cloth band, cut on the cross, a thin sheet of India-rubber, for the purpose of rendering it close fitting to the hat; and, 4th. In making mourning bands of thin sheet India-rubber, and flocking them on the outside with any suitable material.

No claims are given.

William Hunt, Dodderhill, Worcester, chemist. *For improvements in obtaining certain metals from certain compounds, and in obtaining other products by the use of certain compounds containing metals.* Patent dated June 24, 1848; specification enrolled Dec. 23, 1848.

This invention consists of certain modes of obtaining iron from iron slag, copper and tin from copper slag, and the sulphate and carbonate of soda from common salt (chloride of sodium.)

The patentee proposes to run the iron slag into a vessel having a perforated bottom, and placed in a pit filled with water. The vessel is then lifted up by means of suitable hoisting tackle, and the granulated iron emptied out, and mixed with about one-fourth of its weight of small coal or coal-dust. This mixture is placed in a reverberatory furnace, covered with coal dust, and submitted to the action of heat for a time long enough for the oxygen to be disengaged, and the oxide of iron converted into metallic iron. Or it may be converted, after the cementing process, into pig iron or malleable iron, by any of the well-known methods.

Instead of skimming off the copper slag into sand beds, as has hitherto been customary, and allowing it to solidify in masses, it is proposed to run it into water, in the same way as the iron slag, whereby it will be granulated. Or, to crush it by the application of mechanical pressure, the ore is first calcined (for the purpose of freeing it from sulphur), until the proportion of copper is sixty, instead of thirty-five, and then melted in the usual way. The slag, after being separated from the regulus and reduced to a granulated state, is mixed with any sulphurising or deoxidizing substance, such as iron or copper ore, in the proportion of 30 lbs. of copper ore, 40 lbs. of lime, and 20 lbs. of coal dust to one ton of slag, and then submitted to the action of heat; after which it is lixiviated.

Sulphuret of iron, or any cheap sulphuret, may be substituted for the ore, and any suitable flux for the lime.

The mode of obtaining sulphate and carbonate of soda from common salt, consists in mixing it with artificial sulphuret of iron or manganese, or with both combined, or with oxide of iron or manganese, or with both combined, and sulphurous acid, and subjecting it to the action of heat, and of the atmosphere.

Frederick William Mowbray, Leicester, paper dealer. *For improvements in the manufacture of looped fabrics.* Patent dated June 27, 1848; specification enrolled December 26, 1848.

The improvements which form the subject of this patent, consist in combining certain parts in knitting machinery, whereby looped fabrics are produced at a greater speed than hitherto. This combination, which is the result of a peculiar arrangement of suitable gearing, far too complicated to be understood without engravings, has for its object the effecting of the following movements successively, and without loss of time. The cylinder which carries the needles, is made to rotate with a step-and-step motion, whereby the threads are laid across them.